



National Aeronautics and  
Space Administration



## ARSET

Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

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# Wildfire Satellites and Products

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2<sup>nd</sup> International Smoke Symposium Workshop

*NASA ARSET Training on Application of Satellite Remote Sensing Data for Fire and Smoke Monitoring*

November 14, 2016



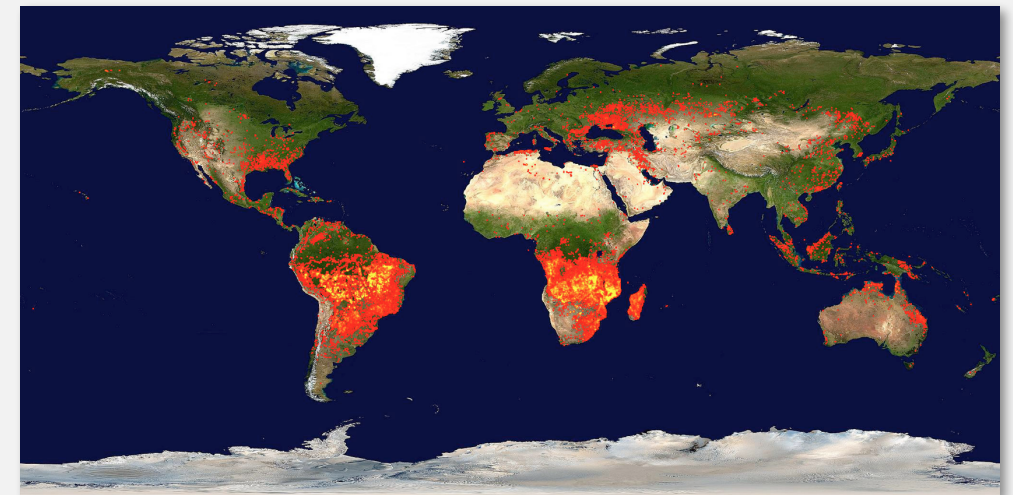
# Lecture Outline

- Wildfire Satellites Review
  - Landsat
  - MODIS
  - Suomi NPP (VIIRS)
  - GOES
- NOAA Fire and Smoke Products
  - WF-ABBA
  - FIMMA
  - HMS
- NASA Fire and Smoke Products
  - MODIS Products
  - FIRMS
  - VIIRS Active Fire Mapper



Left: Smoke and wildfire locations in Northern California from the MODIS satellite on August 5, 2015

Below: Fire hot spot locations globally from MODIS





A satellite image of a landscape with a large wildfire. The fire is a large, bright white and yellow area in the center, with thick black smoke rising from it. The surrounding area is green with some brown patches, indicating a forest or agricultural land. The title 'Wildfire Satellites and Sensors' is overlaid on the image in a black, sans-serif font, with a horizontal line underneath it.

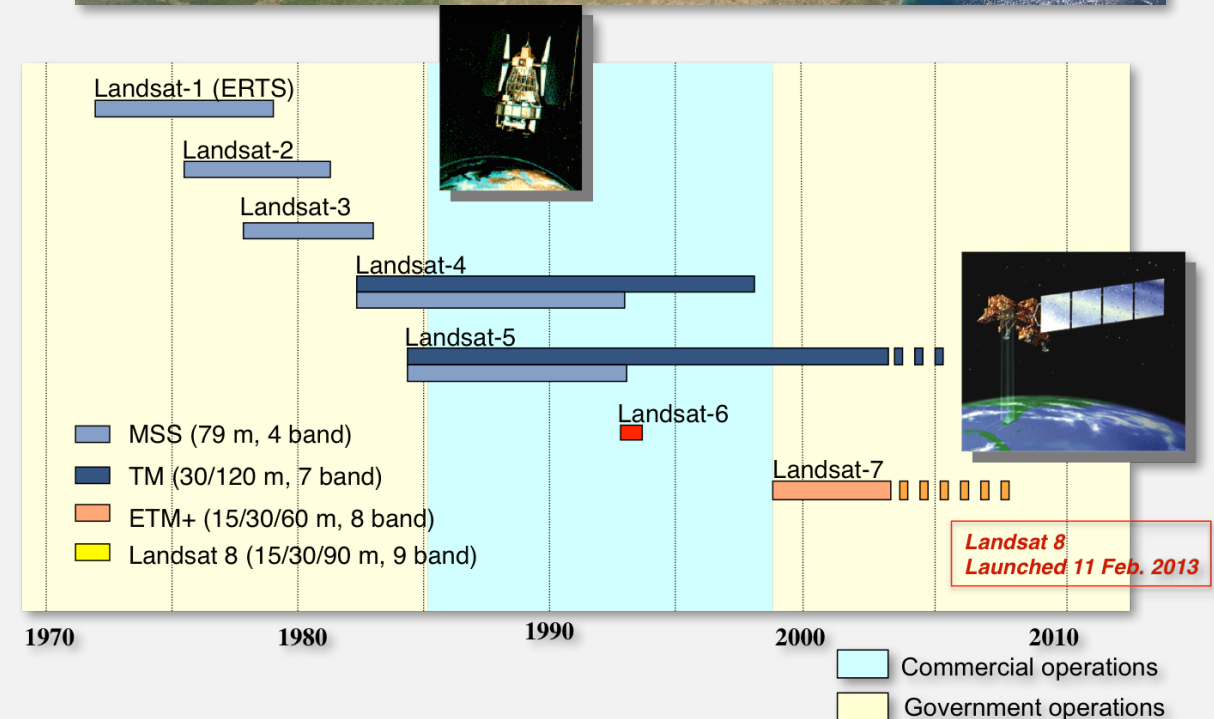
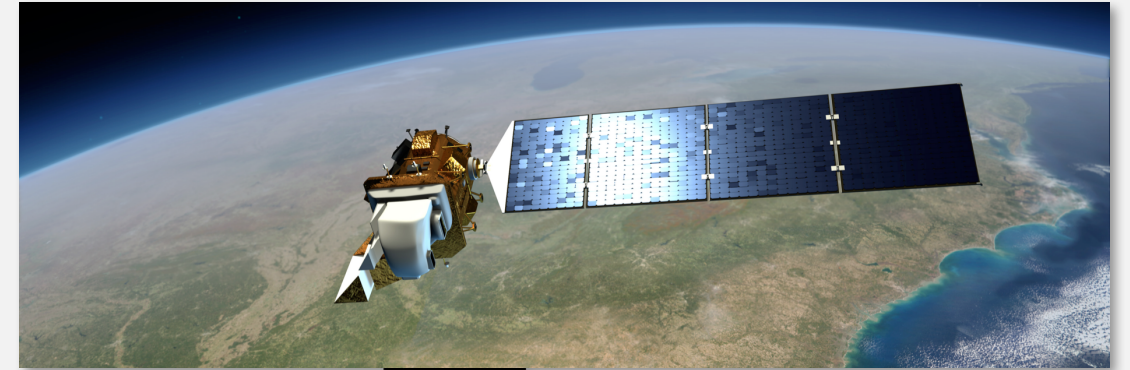
# Wildfire Satellites and Sensors

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# Landsat

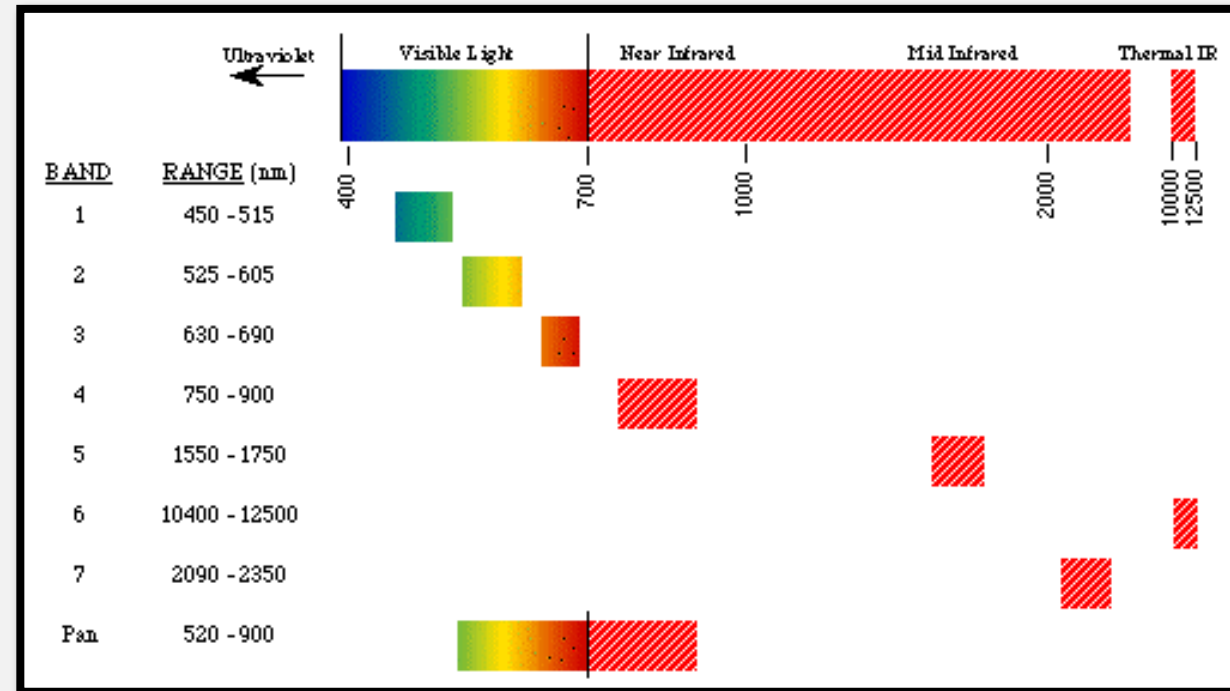
- First Landsat launched in 1972
- Landsat 8 launched in 2013
- NASA created and launched
  - USGS maintains data
- Passive sensor: obtains values of reflectance from Earth's surface
- 30 meter pixels, 15 meter panchromatic band
- Entire image of the Earth every 16 days





# Spectral Characteristics of Landsat

- Landsat instruments measure primarily light that is **reflected** from Earth's surface (with one exception)
- Landsat instruments are designed to detect visible and infrared (near and mid) wavelengths



Landsat bands of ETM+ (Landsat 7)



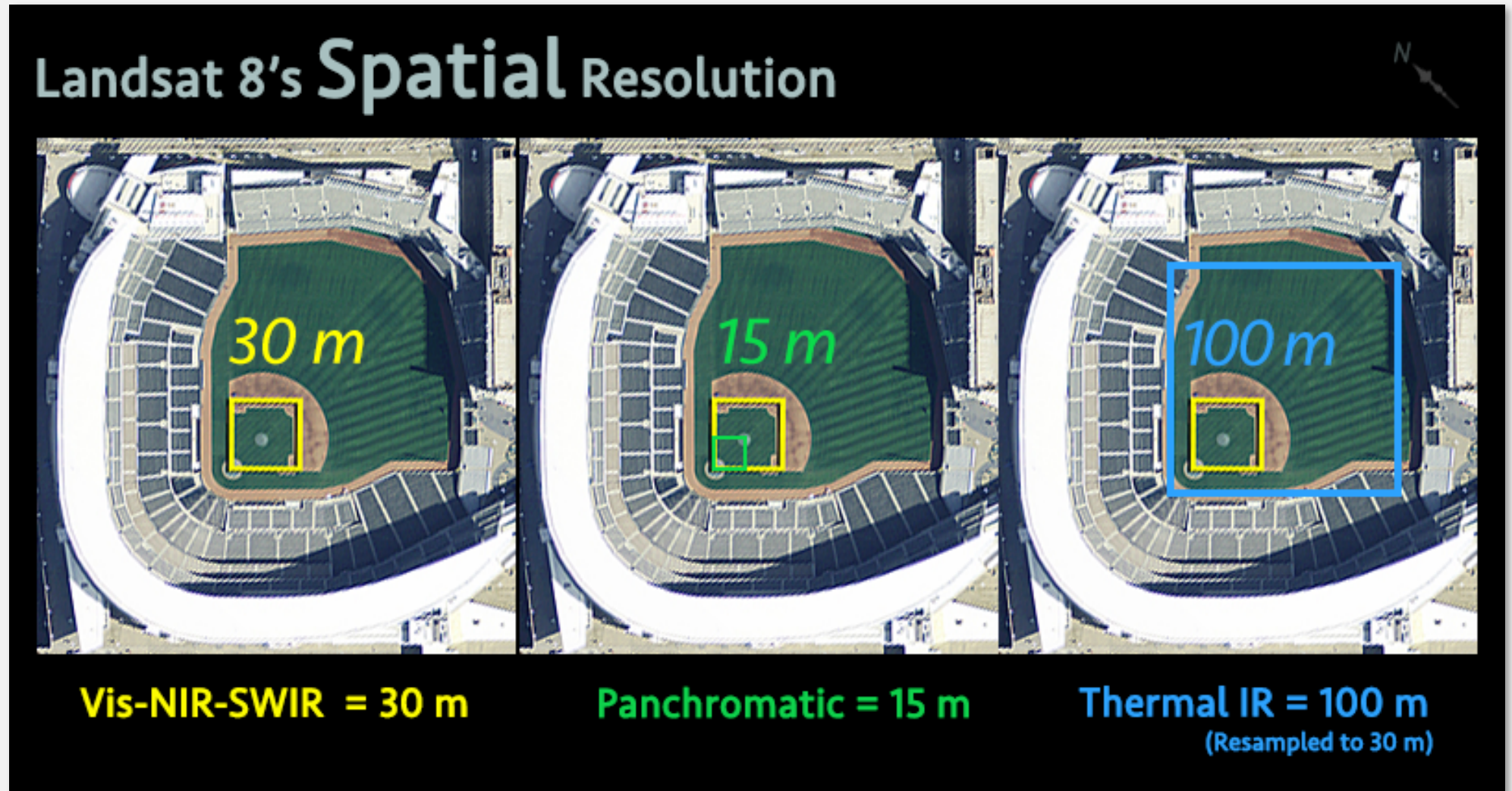


# Landsat Bands

Landsat-7 ETM+ Bands (μm)			Landsat-8 OLI and TIRS Bands (μm)		
			30 m Coastal/Aerosol	0.435 - 0.451	Band 1
Band 1	30 m Blue	0.441 - 0.514	30 m Blue	0.452 - 0.512	Band 2
Band 2	30 m Green	0.519 - 0.601	30 m Green	0.533 - 0.590	Band 3
Band 3	30 m Red	0.631 - 0.692	30 m Red	0.636 - 0.673	Band 4
Band 4	30 m NIR	0.772 - 0.898	30 m NIR	0.851 - 0.879	Band 5
Band 5	30 m SWIR-1	1.547 - 1.749	30 m SWIR-1	1.566 - 1.651	Band 6
Band 6	60 m TIR	10.31 - 12.36	100 m TIR-1	10.60 – 11.19	Band 10
			100 m TIR-2	11.50 – 12.51	Band 11
Band 7	30 m SWIR-2	2.064 - 2.345	30 m SWIR-2	2.107 - 2.294	Band 7
Band 8	15 m Pan	0.515 - 0.896	15 m Pan	0.503 - 0.676	Band 8
			30 m Cirrus	1.363 - 1.384	Band 9

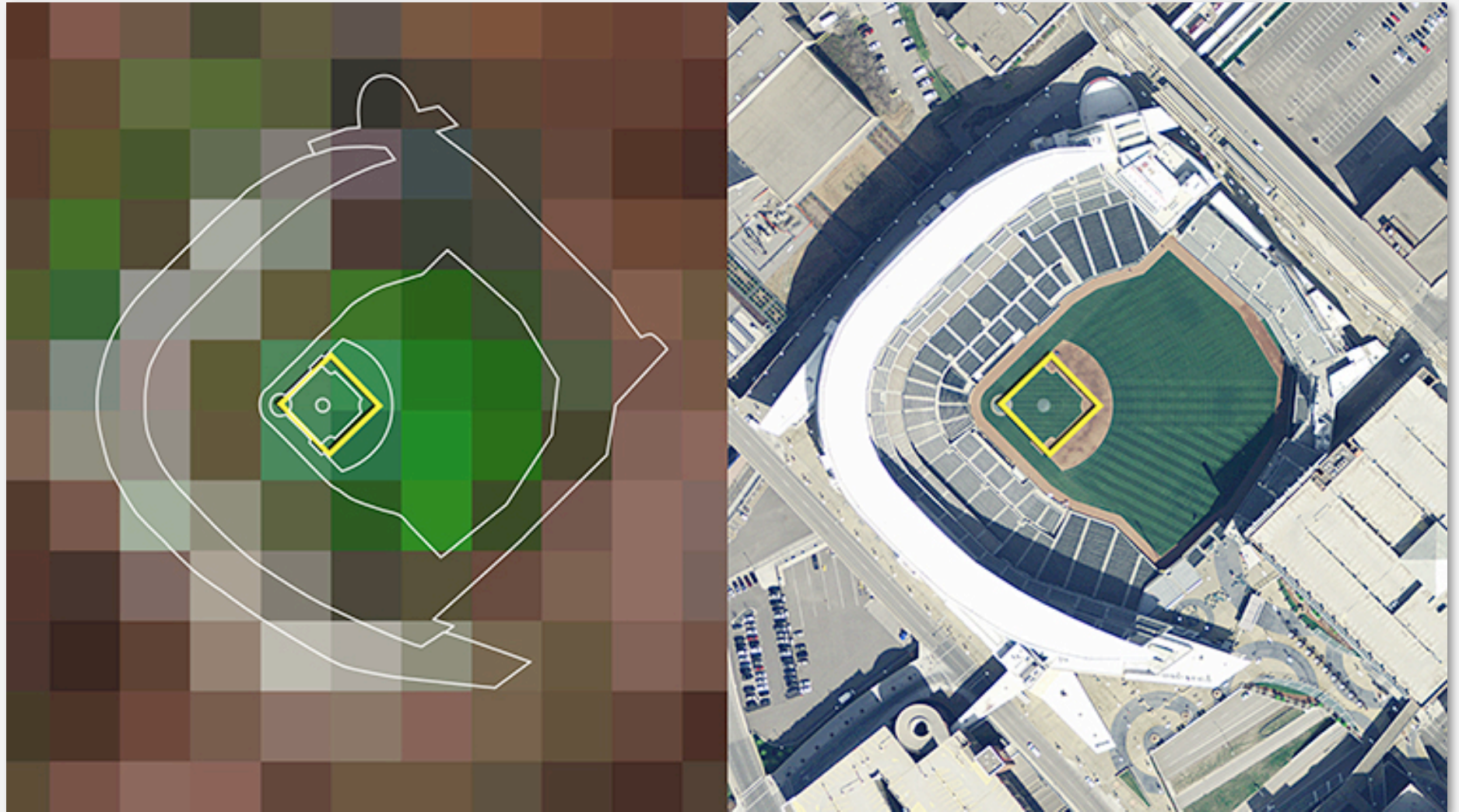


# Landsat Spatial Resolution



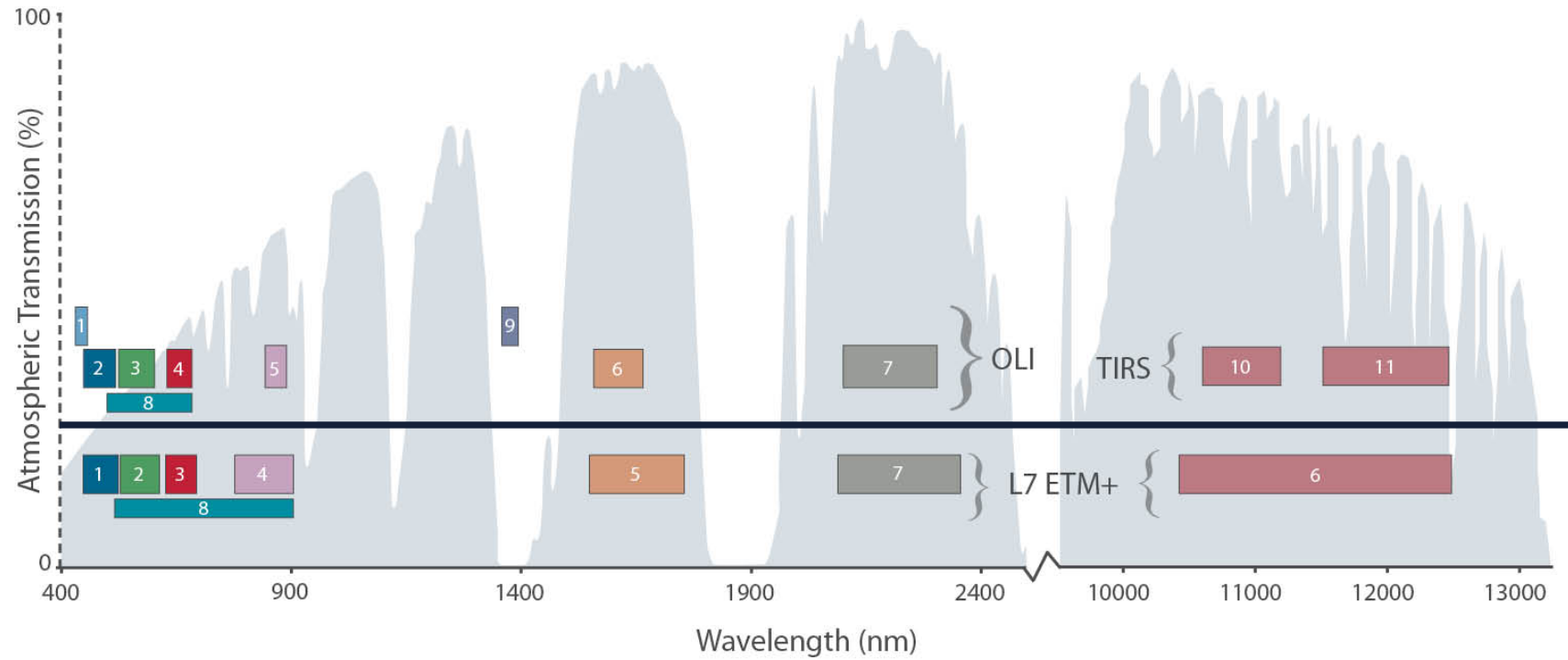


# Landsat Spatial Resolution





# Landsat Bands

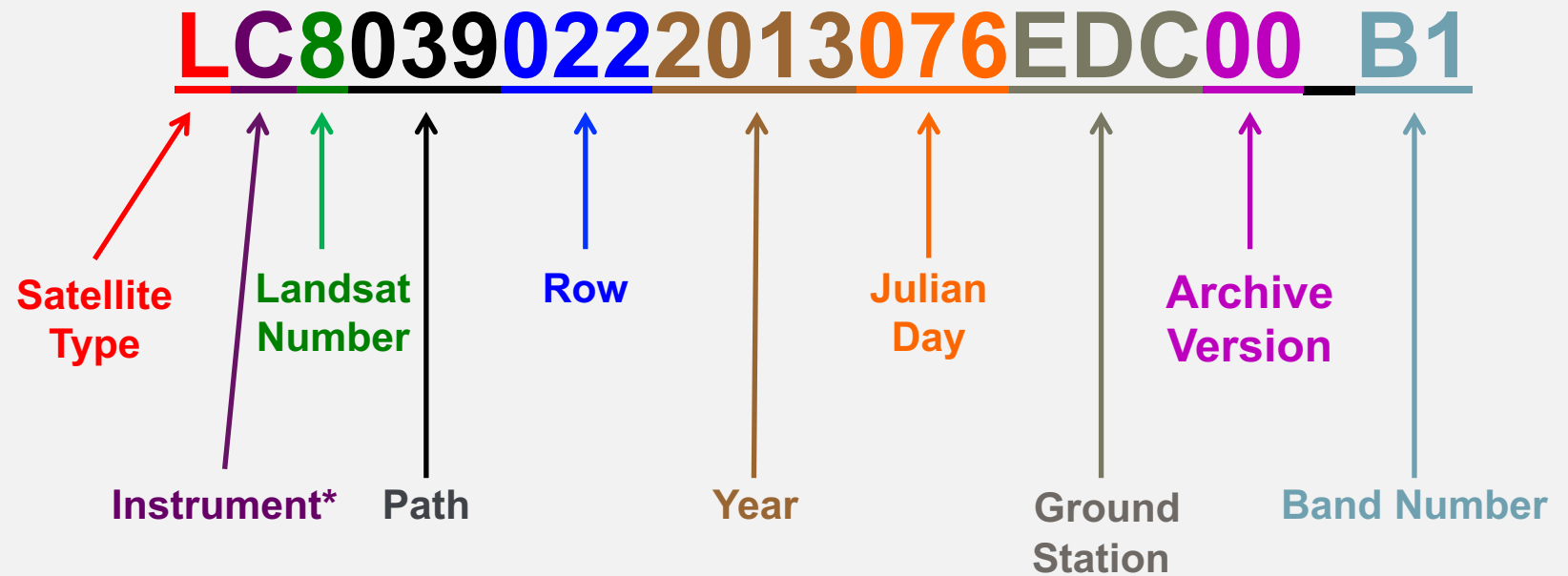


Landsat 8

Landsat 7



# Landsat Naming Convention



\*Instrument can be C: Combined, OLI: Operational Land Imager, or TIS: Thermal Infrared System



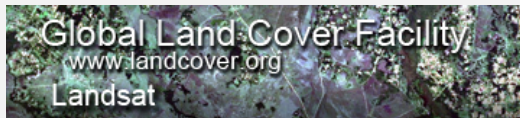
# Where to Obtain Landsat Images



LandsatLook Viewer: <http://landsatlook.usgs.gov/>



GloVis: <http://glovis.usgs.gov/>



Global Land Cover Facility: <http://glcf.umd.edu/data/landsat/>

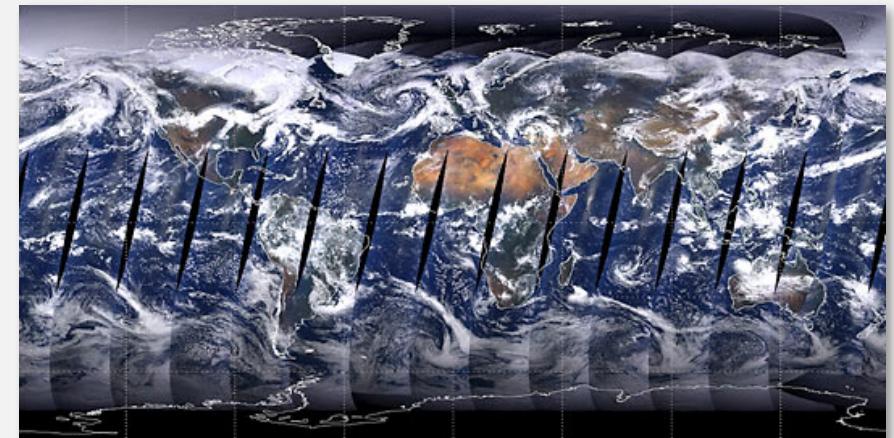
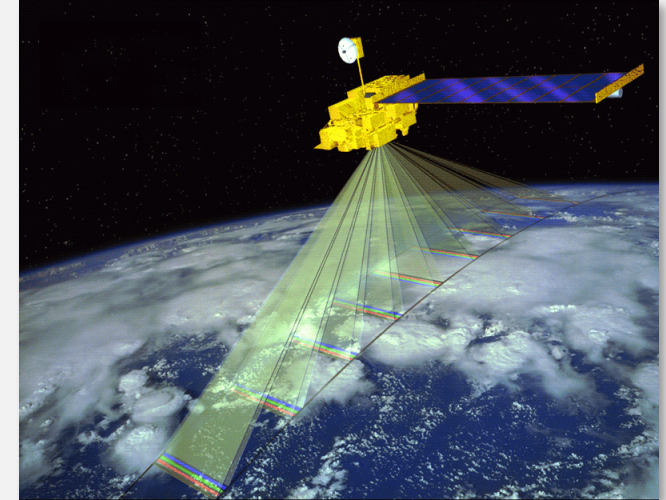


Earth Explorer: <http://earthexplorer.usgs.gov/>



# MODIS

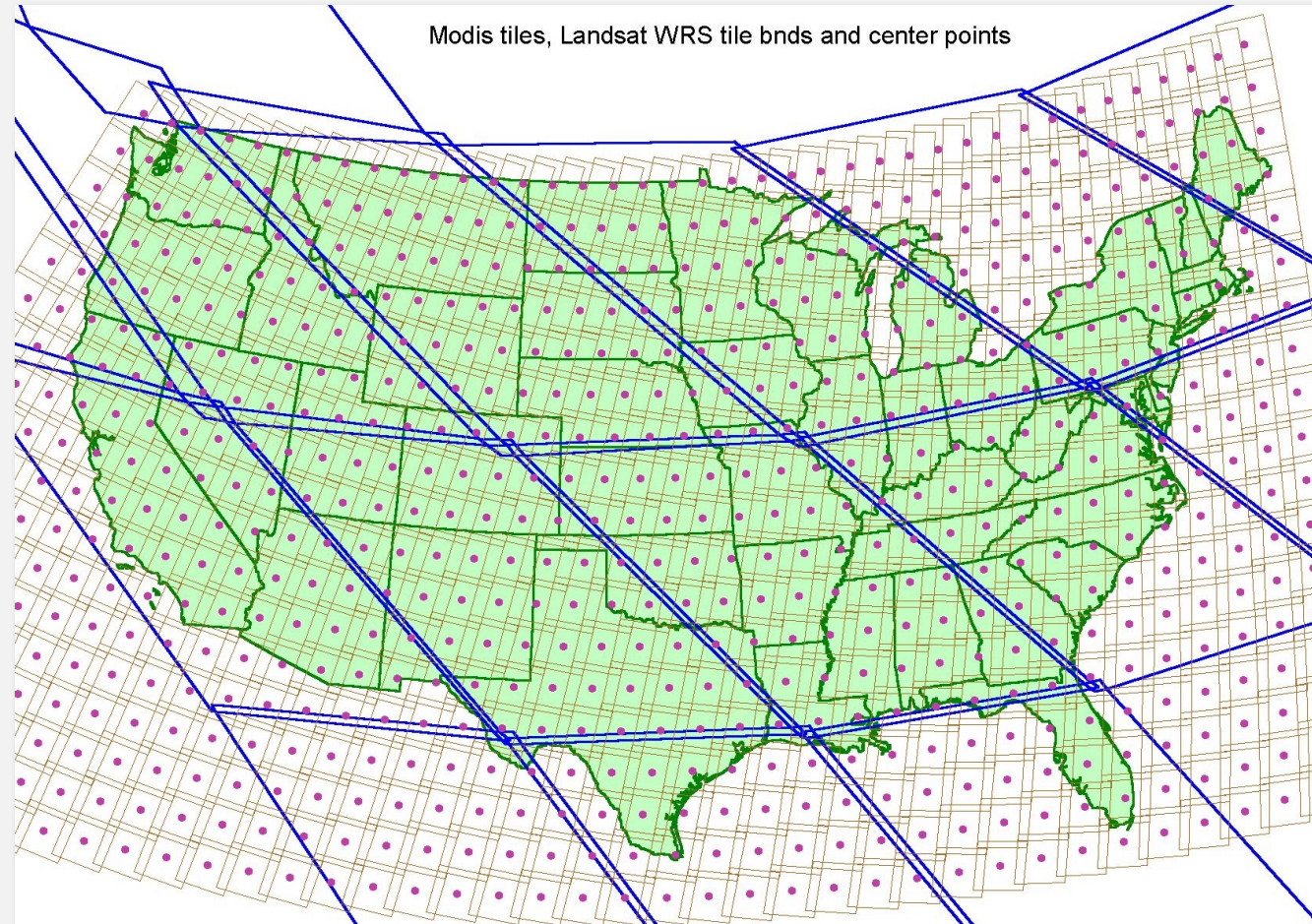
- Spatial Resolution
  - 250 m, 500 m, 1 km
- Temporal Resolution
  - Daily, 8 day, 16 day, monthly, quarterly, yearly
  - 2000–present
- Data Format
  - Hierarchical data format – Earth Observing System Format (HDF–EO8)
- Spectral Coverage
  - 36 bands (major bands include red, blue, IR, NIR, MIR)
    - Bands 1-2: 250 m
    - Bands 3-7: 500 m
    - Bands 8-36: 1000 m





# MODIS vs. Landsat Images

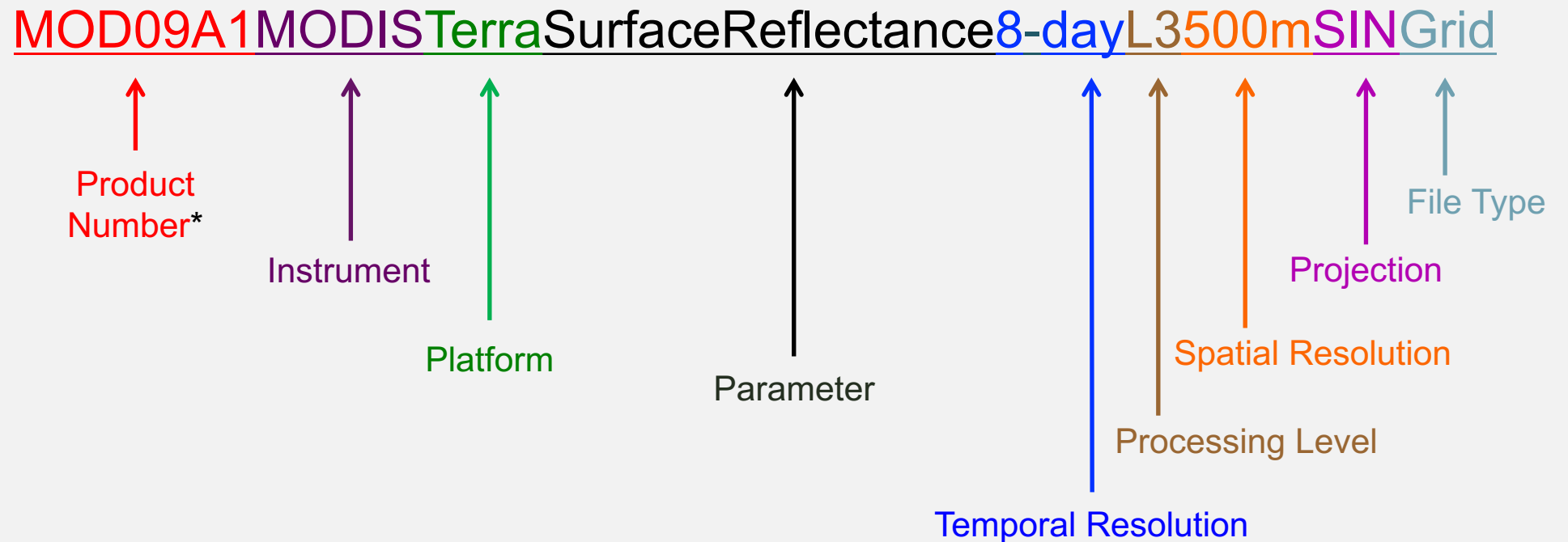
Large swaths!





# MODIS Naming Convention

MODIS file names follow a naming convention that gives useful information regarding the specific product. For example:



\*Note: MOD – Terra; MYD – Aqua; MCD – Combined





# MODIS Land Products

MODIS Name (Short)	Product Name	Spatial Resolution (m)	Temporal
MOD 09	Surface Reflectance	500	8-day
MOD 11	Land Surface Temperature	1000	Daily, 8-day
MOD 12	Land Cover/Change	500	8-day, Yearly
MOD 13	Vegetation Indices	250-1000	16 day, monthly
MOD 14	Thermal Anomalies/Fire	1000	Daily, 8-day
MOD 15	Leaf Area Index/Fraction of Absorbed Photosynthetically Active Radiation (FPAR)	1000	4-day, 8-day
MOD 16	Evapotranspiration		
MOD 17	Primary Production	1000	8-day, yearly
MOD 43	Bidirectional reflectance distribution function (BRDF) /Albedo	500-1000	16-day
MOD 44	Vegetation Continuous Fields	250	yearly
MOD 45	Burned Area	500	monthly



# Where to Obtain MODIS Products



Land Process Distributed Active Archive (LPDAAC)

<http://lpdaac.usgs.gov/>



ECHO Reverb: <http://reverb.echo.nasa.gov>



Worldview (Fires, Land Surface Temperature and Snow Cover): <https://earthdata.nasa.gov/labs/worldview>

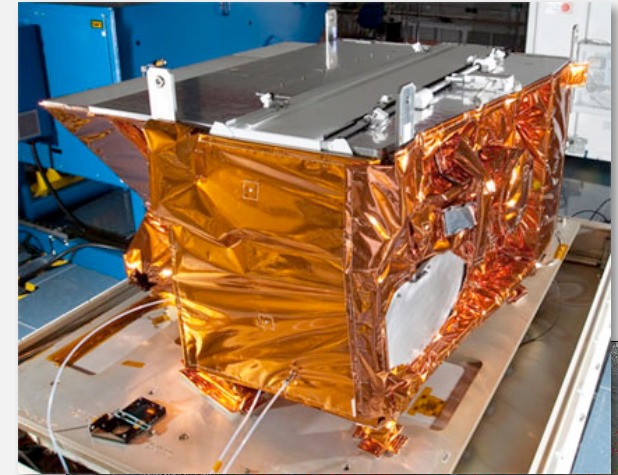


Fire Information for Resource Management System (FIRMS): <https://earthdata.nasa.gov/data/near-real-time-data/firms>

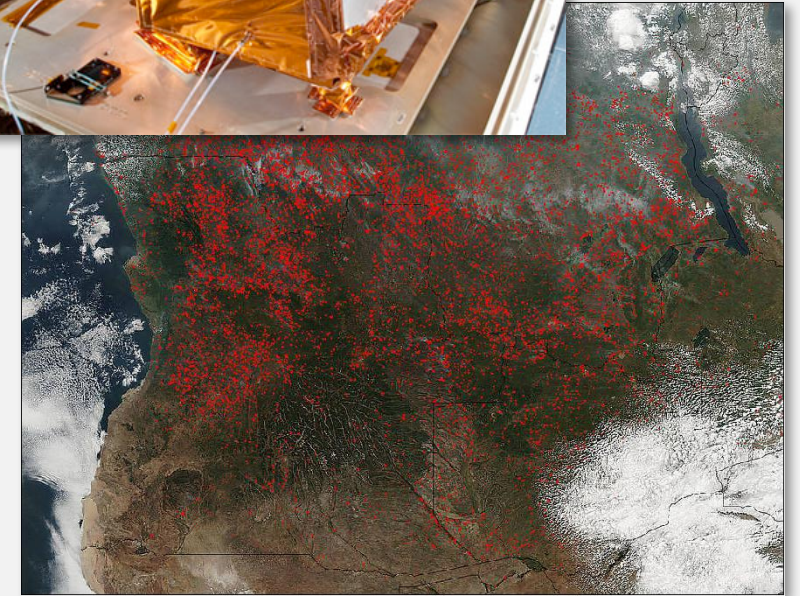


# Suomi NPP: VIIRS

- Visible Infrared Imaging Radiometer Suite (VIIRS): instrument aboard Suomi National Polar-orbiting Partnership (NPP)
- Collects visible and infrared imagery and radiometric measurements
- Launched 2012
  - NOAA took control of operations in 2013
- Daily temporal resolution
  - Global coverage
- Spatial resolution
  - 5 high resolution bands: 375 m
  - 16 moderate resolution bands: 750 m
  - 1 day/night band: can observe fires at night
- Active Fires
  - Detects thermal anomalies (day & night)
  - Fire radiative power (FRP)



VIIRS  
sensor on  
Suomi-  
NPP



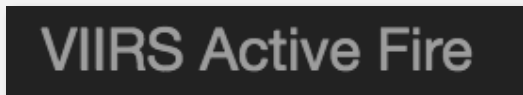
Fires in Central Africa acquired with VIIRS on Suomi-NPP on June 13, 2016 (Image credit: NASA, courtesy of Jeff Schmaltz)



# Where to Obtain VIIRS Land Products



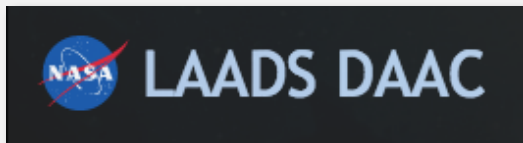
Worldview (Fires, Land Surface Temperature and Snow Cover): <http://earthdata.nasa.gov/labs/worldview>



VIIRS Active Fire:  
<http://viirsfire.geog.umd.edu/pages/about.php>



NOAA Comprehensive Large Array-Data Stewardship System (CLASS): <http://www.class.ngdc.noaa.gov/saa/products/welcome>

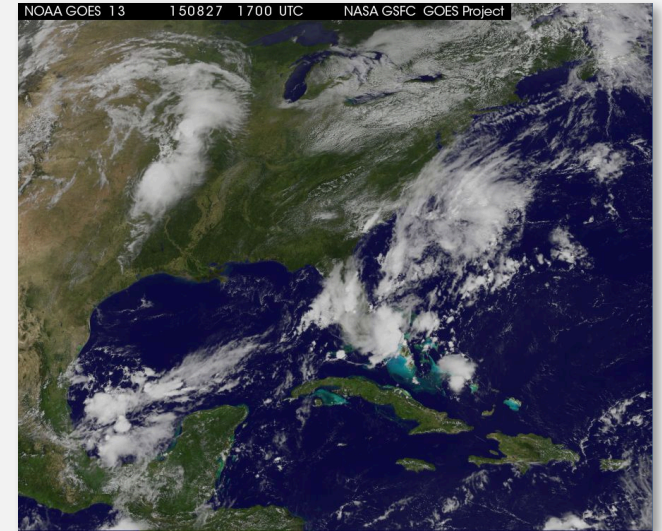
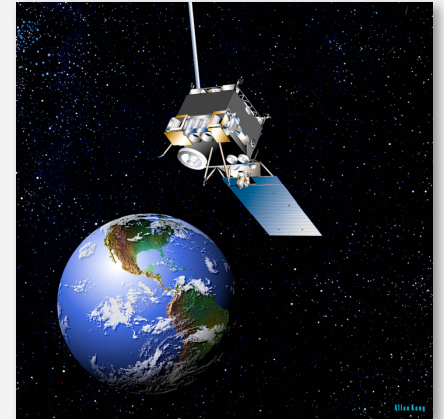


Level-1 and Atmosphere Archive & Distribution System Website: <http://ladsweb.nascom.nasa.gov>



# GOES (Geostationary Operational Environmental Satellites)

- Operated by the NOAA
- Provides data on atmospheric conditions and solar activity
- Geostationary: Fixed position in the sky
- Operates from 2 primary locations
  - GOES East (75° W) for U.S.
  - GOES West (135° W)
- Infrared and visible data
- Resolution:
  - Spatial: 1 km to 16 km (depending on channel)
  - Every 15 minutes



Recent GOES East USA Image



# Where to Obtain GOES Images & Products



NOAA GOES Imagery at a Glance:

<http://www.goes.noaa.gov/>



NOAA CLASS:

<http://www.class.ngdc.noaa.gov/saa/products/welcome>

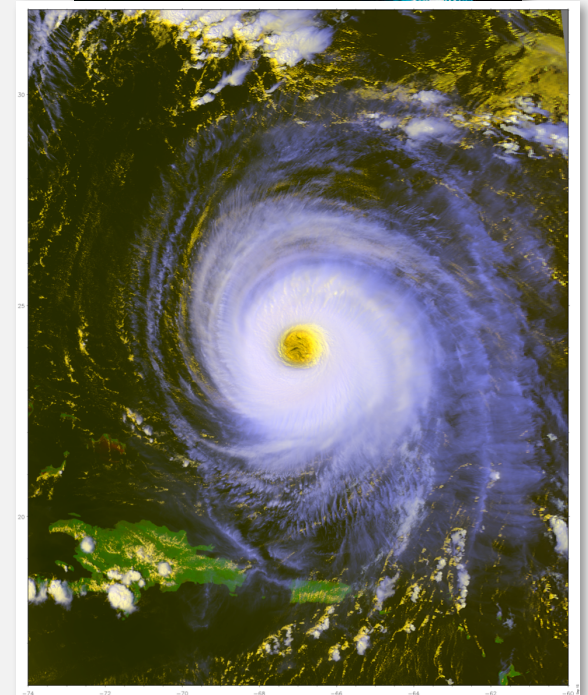


Interactive Global Geostationary Weather Satellite Images: <http://www.ghcc.msfc.nasa.gov/GOES/>



# AVHRR (Advanced Very High Resolution Radiometer)

- Operated by NOAA
- Sensor carried on Polar-Operating Environmental Satellites (POES)
- Infrared and visible data
- Uses:
  - Radiance data for clouds
  - Land-water boundaries
  - Snow and ice extent
  - Surface temperature
- Resolution:
  - Spatial: 1 km
  - Temporal: Global coverage twice per day



AVHRR  
Image of  
Hurricane  
Isabel 2003



A satellite image showing a large area of land with a significant fire. A large, dense plume of white smoke rises from a central point, spreading outwards. The surrounding landscape is a mix of green vegetation and brown, charred areas. A river or stream is visible on the right side. The image is framed by a dark border.

# Landsat Imagery for Wildfires

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# Landsat for Fire Mapping

- Burn Severity:
  - Degree to which a site has been altered or disrupted by fire
  - Loosely, a product of fire intensity and residence time
  - The effect of a fire on ecosystem properties, often defined by the degree of mortality of vegetation
- How do we connect pixels in a satellite image to burn severity?
  - Use spectral properties

Left: Landsat image from September 15, 2016. False color image shows extent of the Soberanes Fire in California

Right: Post-wildfire landscape. Image Credit: Bcasterline





# Landsat for Post-Fire Mapping

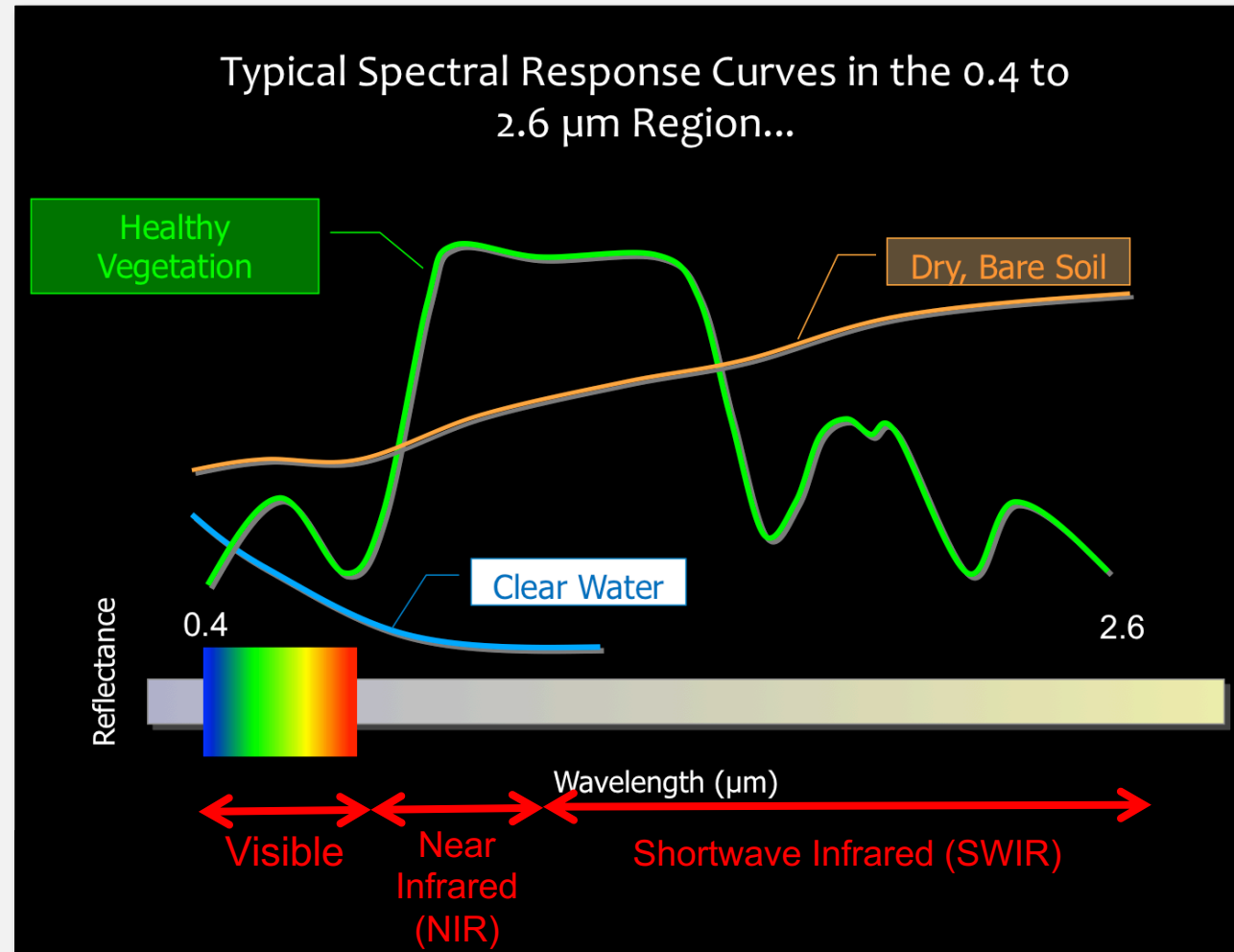


Figure modified from USDA Forest Service RSAC Program



# Landsat for Post-Fire Mapping

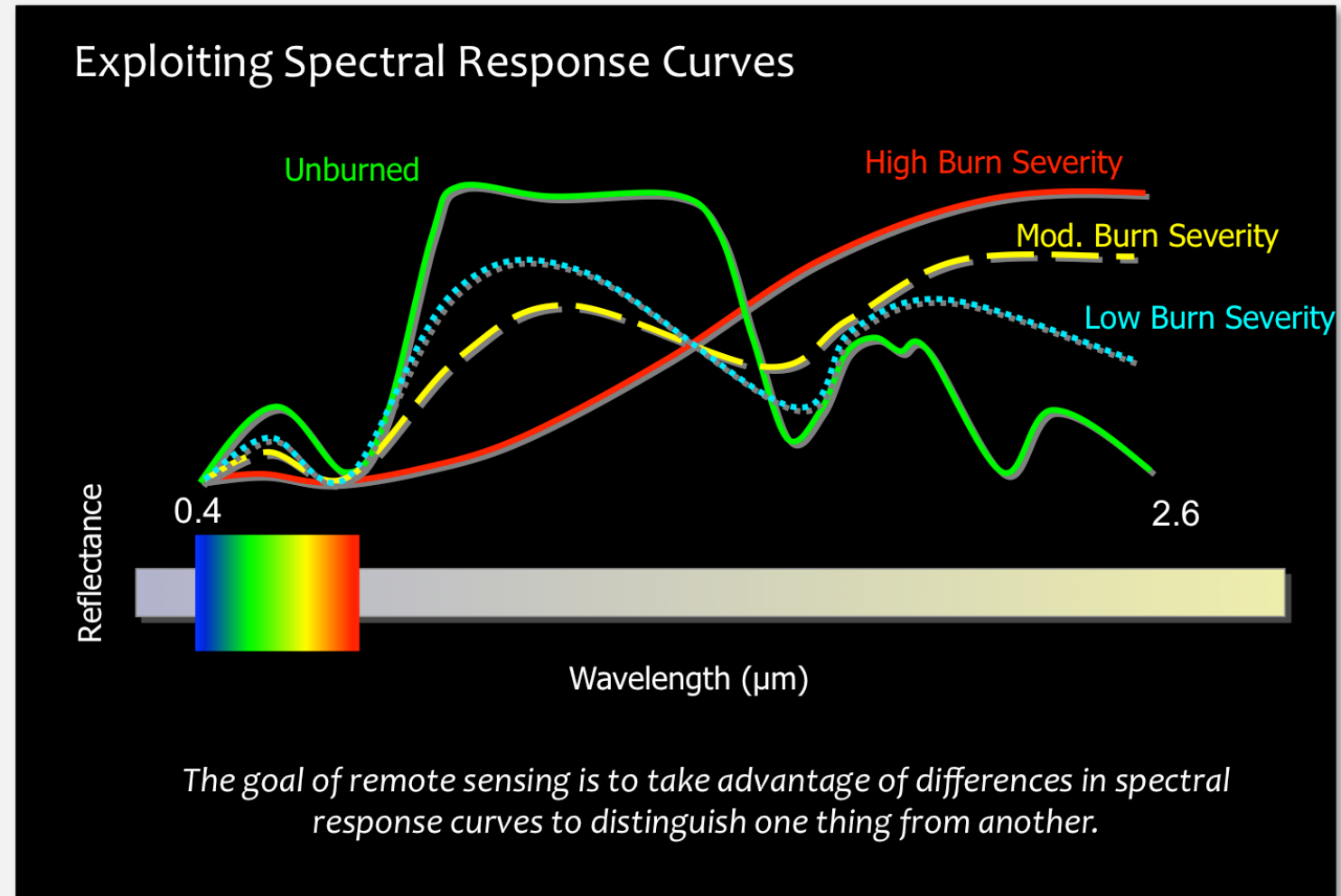


Figure modified from USDA Forest Service RSAC Program



# Landsat for Post-Fire Mapping

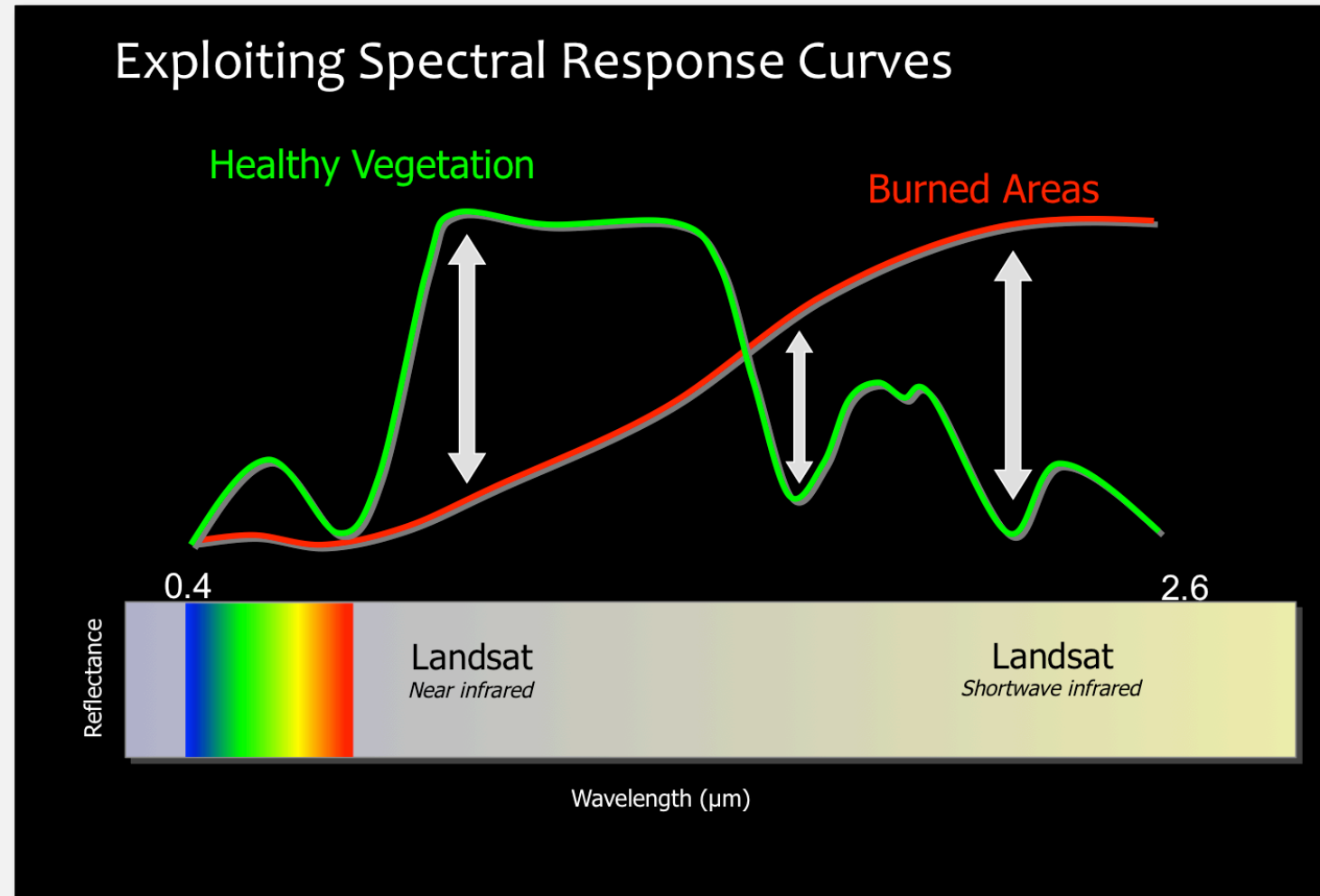


Figure modified from USDA Forest Service RSAC Program

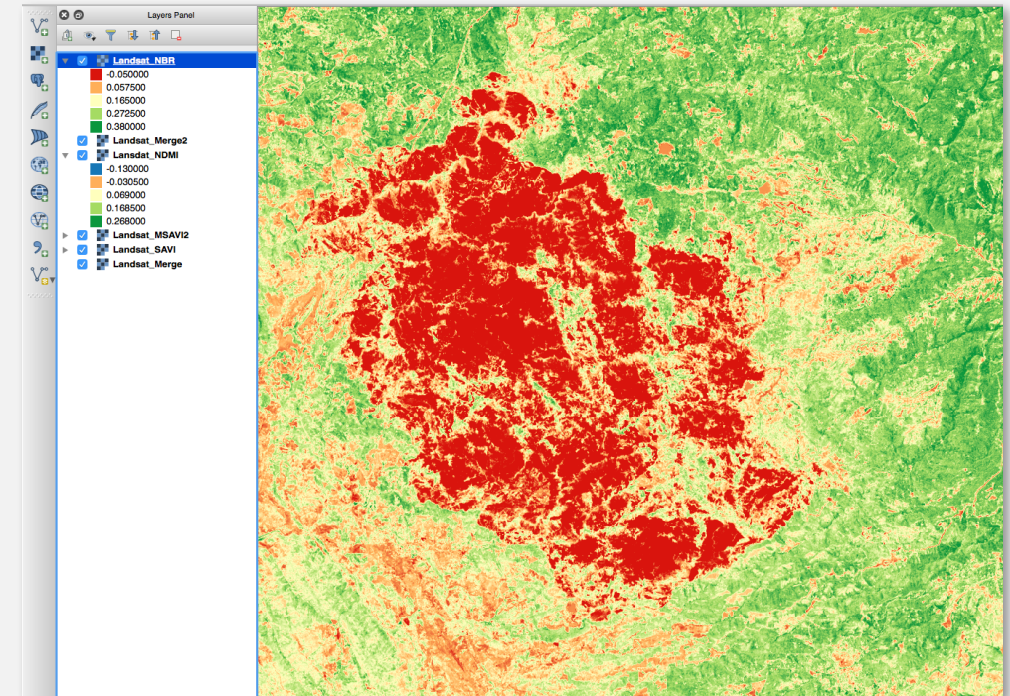


# Normalized Burn Ratio

- Used to identify burned areas
- Compare pre- and post-burn to identify burn extent and severity
- Use Band 7 for SWIR in Landsat 8 images
- Can be used to create a Burned Area Reflectance Classification (BARC)
  - Input to a Burn Severity Map

$$NBR = \frac{(NIR - SWIR)}{NIR + SWIR}$$

Example of NBR using Landsat in QGIS software. This is the NBR of the Rim Fire in California from August 2013



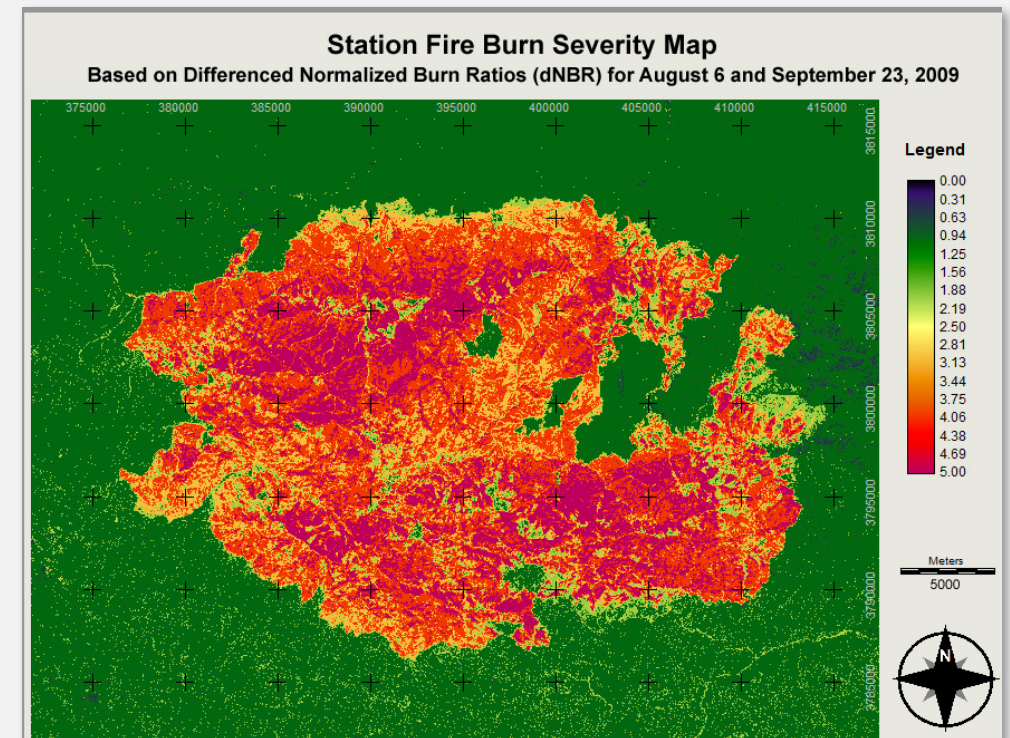


# Landsat for Post-Fire Mapping

- Need at least 2 images:
    - One pre-burn
    - One post-burn
1. Create NBR for each image
  2. Subtract post-fire image from pre-fire image
  3. Evaluate differenced map

Example of dNBR from the Station fire in Angeles National Forest from August-September 2009.  
Image Credit: Irene Nester

$$dNBR = NBR_{prefire} - NBR_{postfire}$$





# Monitoring Trends in Burn Severity

<http://www.mtbs.gov/>

- Project designed to consistently map burn severity and fire perimeters across the U.S.
  - Partnership between USGS & USDA Forest Service
- Remote sensing and ground-based assessments
- Outputs
  - NBR from Landsat (pre- and post-fire)
  - Differenced NBR (dNBR)
  - Classification of burn severity
    - Based on pre and post imagery, plot data, & analyst's experience with fire behavior
  - Fire Perimeter
  - Geospatial Metadata

Monitoring Trends in Burn Severity (MTBS)

Home

What's NEW?

Background and Partners

Documents and References

Methods

Product Descriptions

Mapping Status

Applying MTBS Data

Project Reports

Data Access

Tech Transfer

Glossary

Related Websites

FAQs

USGS

RSAC

MTBS

Forest Service: Accessibility Privacy Policy Important Notices FOIA

MTBS Data Search and Distribution Tools

Query Builder

Selection Criteria:

Temporal Spatial Name Admin Ownership Size Type Assessment Type Data Version

☒ Fire Occurrence Date ☐ Release Date

Fire Occurrence Date

For fire occurrences in a specific time period, choose "Select Date Range" and specify the beginning and ending dates by clicking on the calendar icon below and selecting a month, day and year.  
For all available fire datasets, choose "All Years".

☒ Select Date Range ☐ All Years

From:  To:

Currently Specified Selection Criteria: (only currently enabled criteria below will be applied to the query)

☐ Fire occurrence dates have not been selected.

☐ Area of Interest has not been selected

☐ Fire Names have not been selected

☐ Administrative Ownership category has not been defined.

☐ Fire size has not been defined.

☒ Fire Types: WF, RX, WPU, UNK

☒ Assessment Type: Both Initial and Extended Assessments

☒ Dataset Version Status: Both Original and Revised Datasets

Query Results

MTBS Data search



A satellite image showing a large fire burning in a forested area. Thick white smoke is rising from the fire, partially obscuring the landscape. The surrounding area is green, indicating dense vegetation. The fire is located in the lower right quadrant of the image.

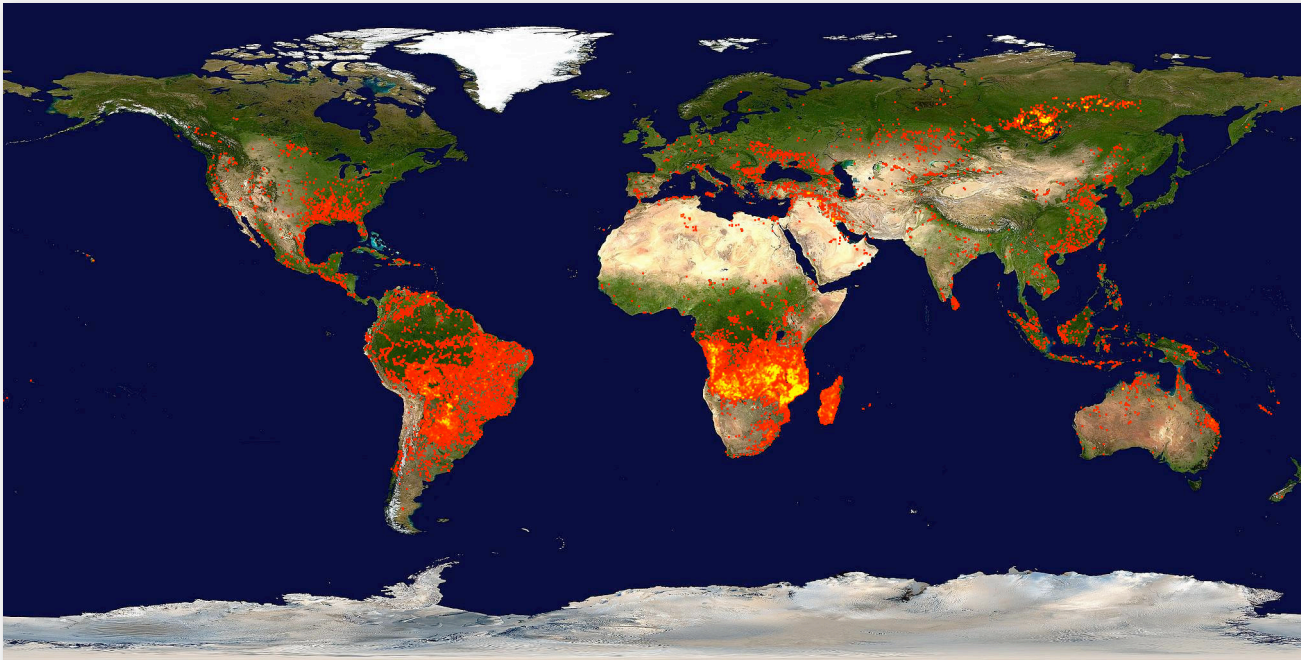
# NASA Fire and Smoke Products

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# MODIS Fire Products

- Near Real-Time Thermal Anomalies and Fire Locations
- Provides snapshots of active burning fires and burned areas
- The Active Fire product delivers actively burning locations on a daily basis at 1 km resolution (additional 8 day and monthly products)



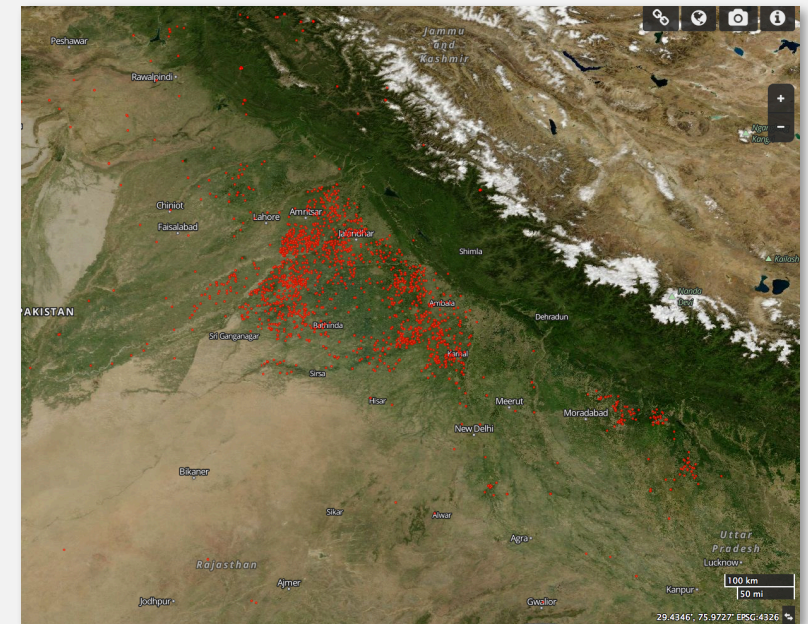
**Global Fire Map  
(September 17–  
September 26, 2016)**

Colors range from red, where the fire count is low, to yellow where the number of fires is large



# MODIS: Thermal Anomalies Algorithm

- MODIS Fire Detect: Represents the center of a 1 km pixel flagged as containing one or more fires within the pixel
  - Can also detect volcanic signatures
- Looks for significant increase in absolute radiance at  $4\mu\text{m}$  (band 22) and  $11\mu\text{m}$  (band 31)
  - Sun glint removed and cloud masks applied
  - VIIRS Active Fire Detect Algorithm similar
- Potential fire pixel:
  - Daytime  $> 305\text{ K}$
  - Nighttime  $> 310\text{ K}$
- Limitations
  - False positives: small forest clearings (bare soil)
  - Large fire omissions due thick smoke
  - Collection 6 (most recent) improves upon these errors
    - Global commission error of 1.2%

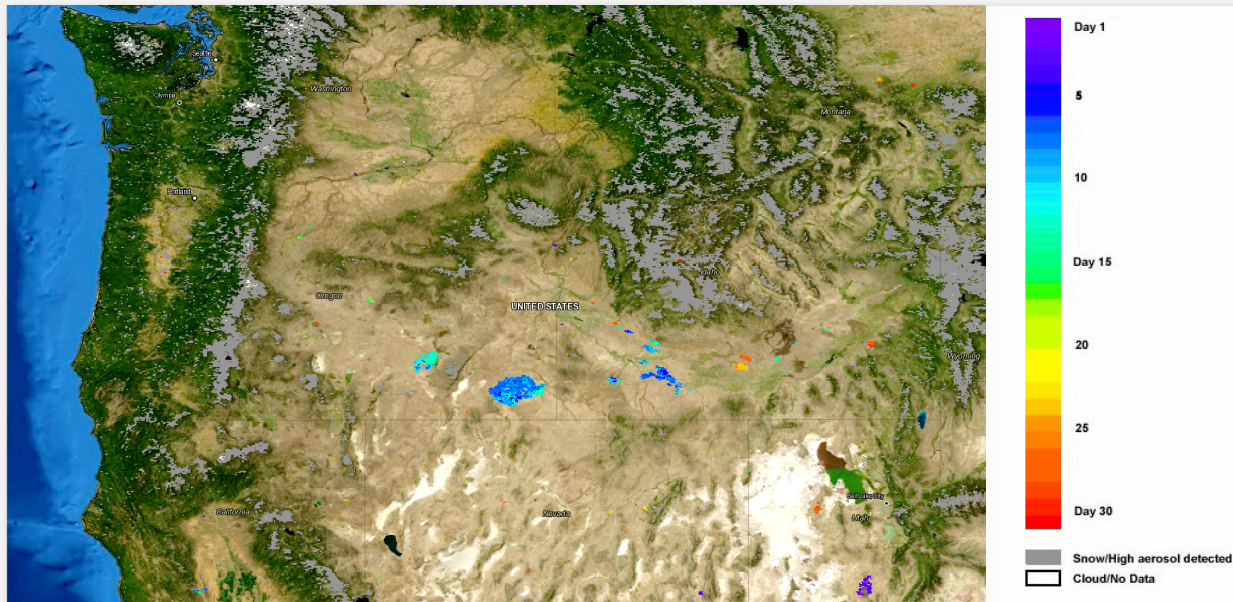


MODIS fire detects from NASA  
Worldview



# MODIS Land Products: Burned Area (MCD45A1)

- The combined Terra & Aqua MODIS Burned Area Product is a monthly gridded 500m product
- MODIS detects the approximate date of burning at 500m resolution
- Maps include the spatial extent of recent fires
- For more information: <http://modis-fire.umd.edu>



This image shows the extent of the Long Draw fire that occurred in southeastern Oregon. The colors represent the approximate day of the burning from July 8 (start of fire) to July 12, 2012 (end of fire)



# Fire Information for Resource Management System (FIRMS)

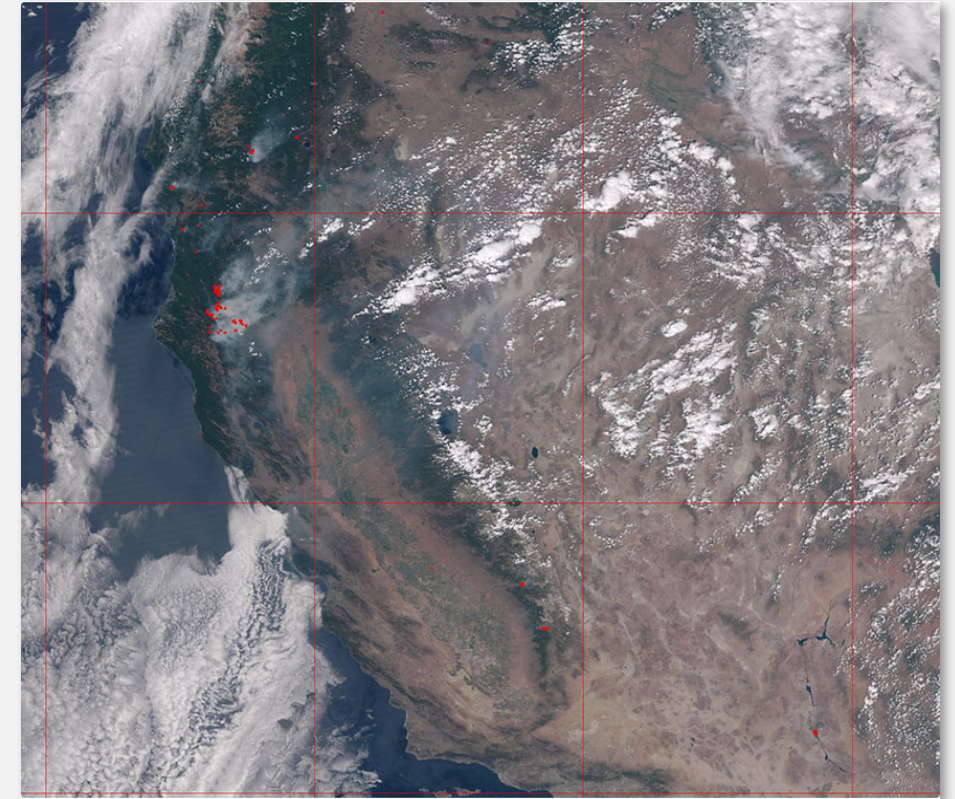
- Distributes near real-time (NRT) active fire data within 3 hours of satellite overpass
- Delivers global MODIS and VIIRS hotspots/fire locations and MODIS burned area images
- Provides historical data (older than 7 days) using the Archive Download Tool
- Available in various formats:
  - Email alerts
  - GIS-friendly file format
  - Visualization in **Web Fire Mapper** or **Worldview**
- Exercise on this tool in upcoming session

The screenshot displays the EarthData website's interface for the Fire Information for Resource Management System (FIRMS). The top navigation bar includes links for ABOUT, DATA, COMMUNITY, and RESOURCES. A search bar is located on the right. The main content area features a sidebar with 'Data' and 'Related Content' sections. The 'Data' section lists disciplines, and 'Related Content' includes links to typhoon Megi, LANCE survey feedback, and fires in Russia. The main content area highlights the 'Fire Information for Resource Management System (FIRMS)' and states that it delivers global hotspots and fire locations in easy-to-use formats. It mentions that FIRMS distributes Near Real-Time active fire data within 3 hours of satellite overpass from both MODIS and VIIRS. Below this, there are buttons for 'MODIS Active Fire Products' and 'VIIRS Active Fire Products'. A 'Get hotspot/fire locations' section is also visible, containing links for 'Fire Email Alerts', 'Download Active Fire Data', 'Web Fire Mapper', 'Global Fire Maps', and 'Web Services'.



# VIIRS Active Fire Product

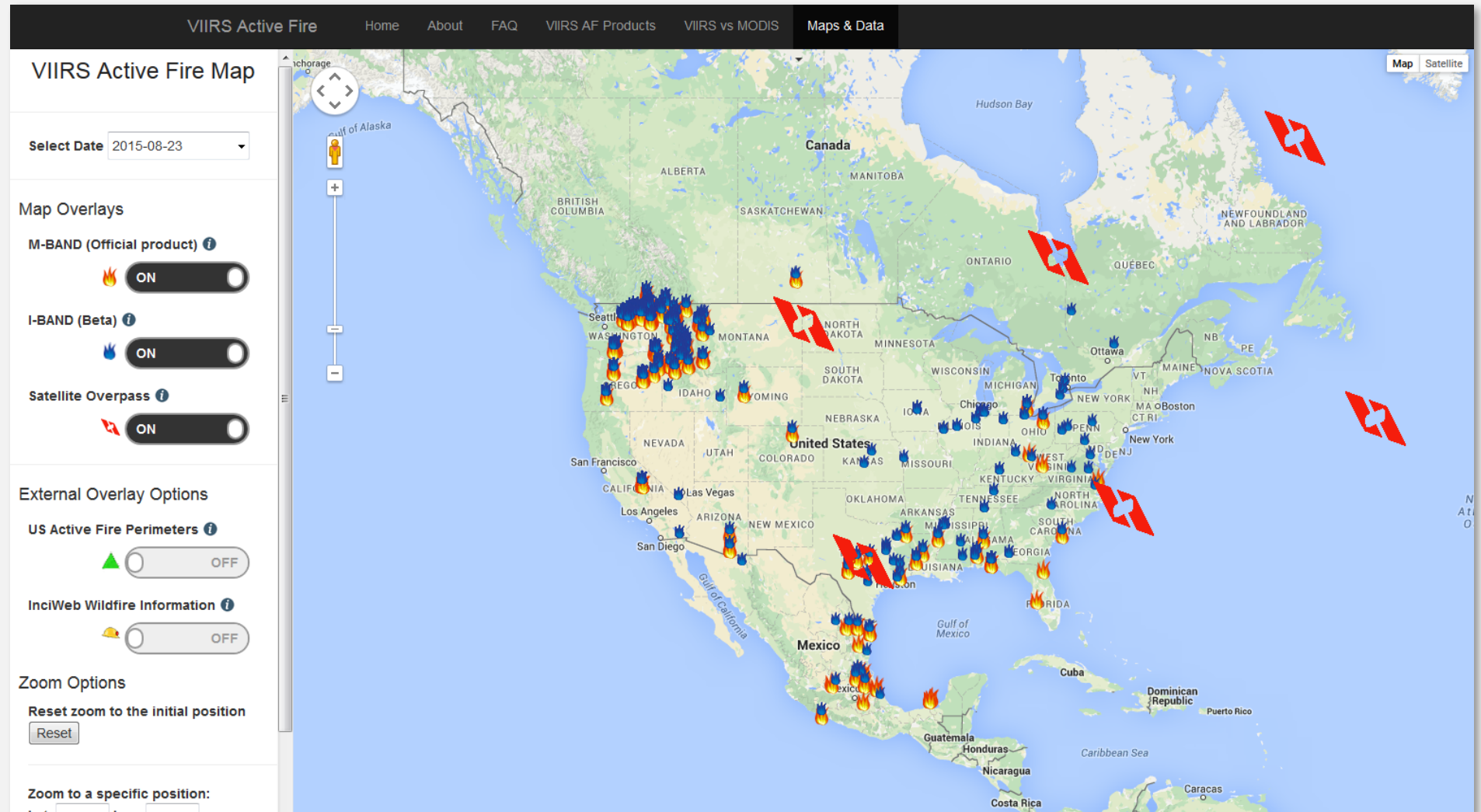
- Released October 22, 2012
- Spatial resolution:
  - 750m (M-band)
  - 375m (I-band)
- Data are still preliminary (i.e. Beta) and continue to undergo evaluation & calibration
- Data available as:
  - ASCII
  - PNG (I-band only)
  - KMZ
  - GeoTIFF (I-band only)
  - TIFF
  - KML (I-band only)



Northern California fires 2015

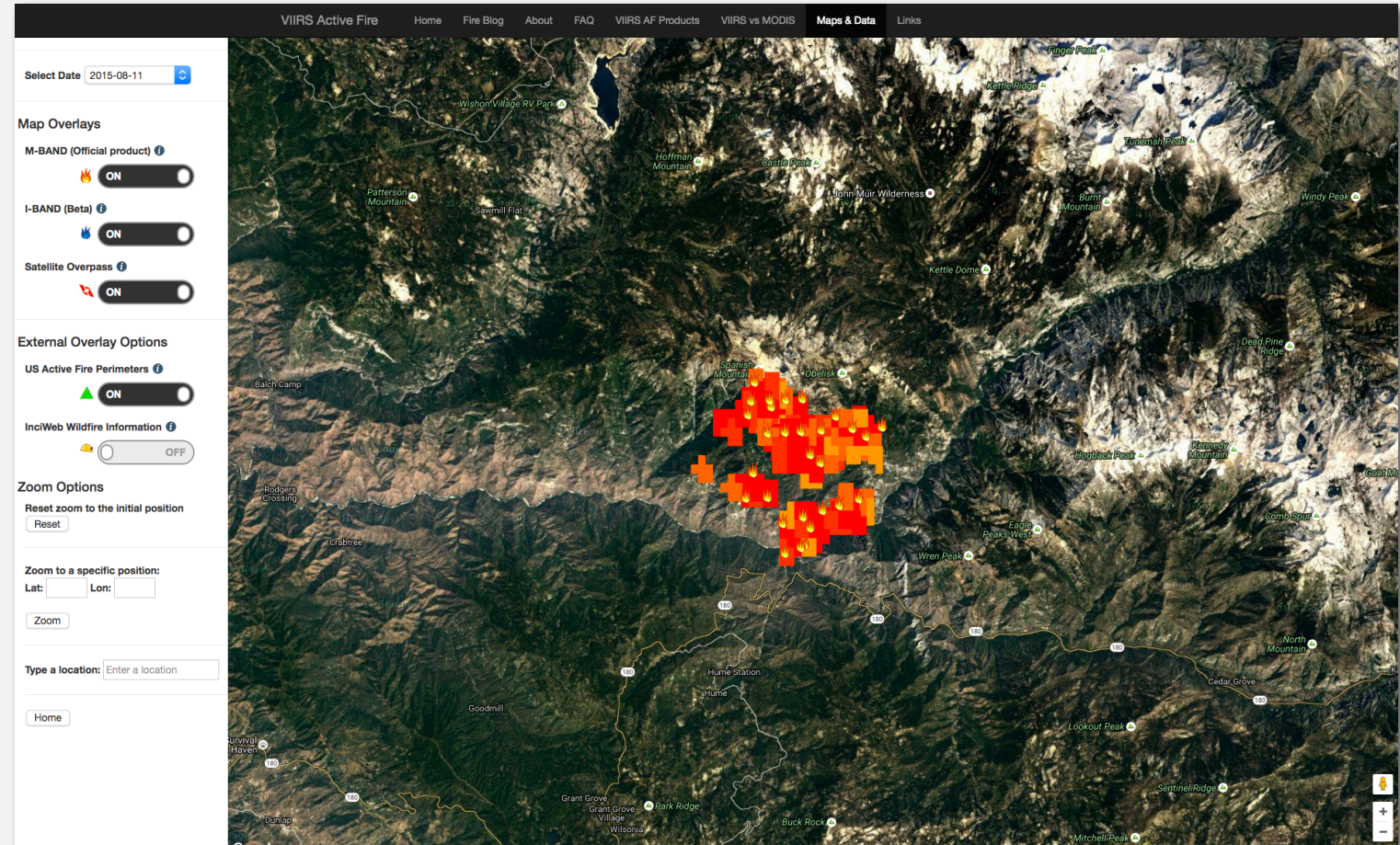


# VIIRS Active Fire Map (CONUS)





# VIIRS Active Fire Map (CONUS)



The Rough Fire near Kings Canyon National Park. Image: August 11, 2015, identifies fire locations (thermal anomalies from VIIRS) and Active Fire Perimeters (US Forest Service).



An aerial photograph of a forest fire. A large, dense plume of white smoke rises from a fire burning in a forested area. The surrounding landscape is a mix of green forest and brown, charred ground. The smoke plume is the central focus, extending from the bottom right towards the top left of the frame.

# NOAA Fire and Smoke Products

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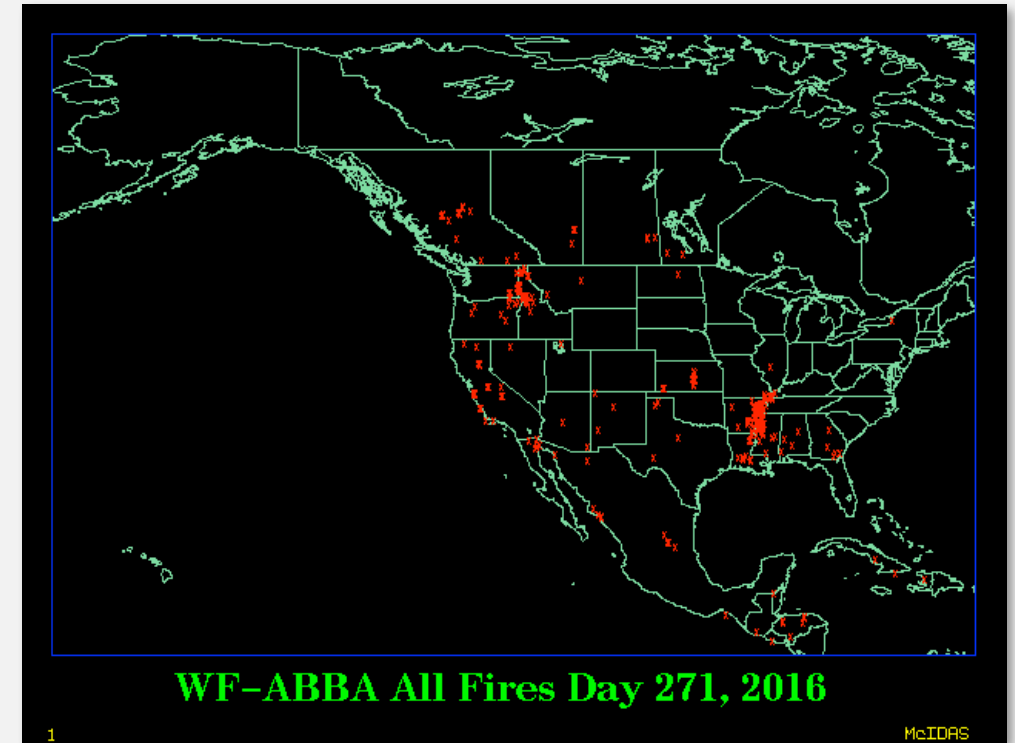




# Wildfire Automated Biomass Burning Algorithm (WF-ABBA)

<http://www.ssd.noaa.gov/PS/FIRE/Layers/ABBA/abba.html>

- Developed in collaboration with the Cooperative Institute for Meteorological Studies (CIMSS), University of Wisconsin
- Uses the **GOES Imager** to detect and monitor fires throughout the Western Hemisphere
- Product is run half-hourly
- Minimum detectable fire size: .5 to 1 acre
- Data are available for download: ASCII, GIS and graphic formats
- *This product has NOT been quality controlled*



The red “X’s” indicate hot spots

Fire locations represent the approximate location of the fire pixel, not the actual fire size.

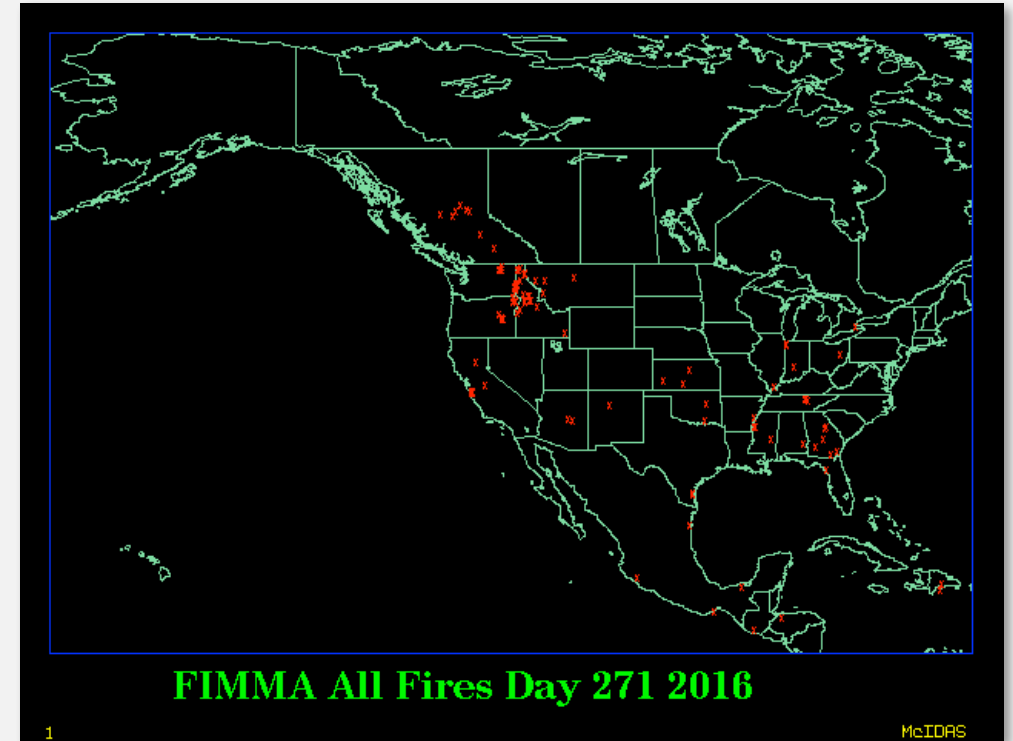




# Fire ID, Mapping, & Monitoring Algorithm (FIMMA)

<http://www.ssd.noaa.gov/PS/FIRE/Layers/FIMMA/fimma.html>

- Detects fires from **AVHRR**
- Data are available near real-time, approximately 3-6 hours after satellite overpass
- This algorithm is only accurate over forested regions
- Data are available for download in ASCII, GIS and graphic formats
- *This product has NOT been quality controlled*



The red “X’s” indicate hot spots

Fire locations represent the approximate location of the fire pixel, not the actual fire size.





# NOAA Hazard Mapping System Fire & Smoke Product (HMS)

<http://www.ospo.noaa.gov/Products/land/hms.html>

- Shows detected hot spots, smoke plumes and estimated smoke concentrations
- Blended product from GOES, POES AVHRR and MODIS
- Spatial resolution: 4 km
- Product provided once daily

NOAA OFFICE OF SATELLITE AND PRODUCT OPERATIONS  
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE

ORGANIZATION SERVICES PRODUCTS OPERATIONS

## Hazard Mapping System Fire and Smoke Product

Current HMS Analysis

Analysis for day 9/28/2016 last updated at 9/28/2016 15:48:09 GMT

GISPreview  
Download GIS files from  
<ftp://satapsanone.nesdis.noaa.gov/FIRE/HMS/GIS/>

Current HMS Fire and Smoke Analysis

Google KML files: [Fire](#) | [Smoke](#)

### Real-Time Satellite Imagery Loops

GOES West GOES East Active Fire Floater Imagery NASA MODIS Rapid Response




# NOAA Fire Product Archive

<http://satepsanone.nesdis.noaa.gov/FIRE/fire.html>

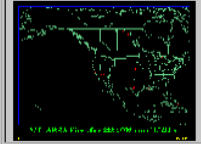
- Archive of fire products for up to 90 days
- Products include ABBA, FIMMA, HMS and MODIS
- Available in various formats: graphic, text, GIS and KML

**Fire Products Archive**

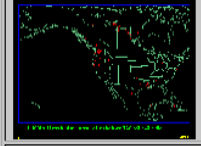
Select the following options to view or download products:



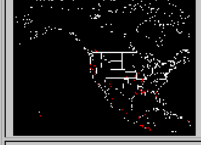
HMS



ABBA-GOES



FIMMA-AVHRR



MODIS

**WHAT FIRE PRODUCT?**

NONE   
ABBA  
MODIS  
FIMMA  
HMS

**WHAT FORMAT?**

NONE

**TIME PERIOD?**

Current Day  
Last 2 Days  
Last 7 Days  
Longer Term Archive

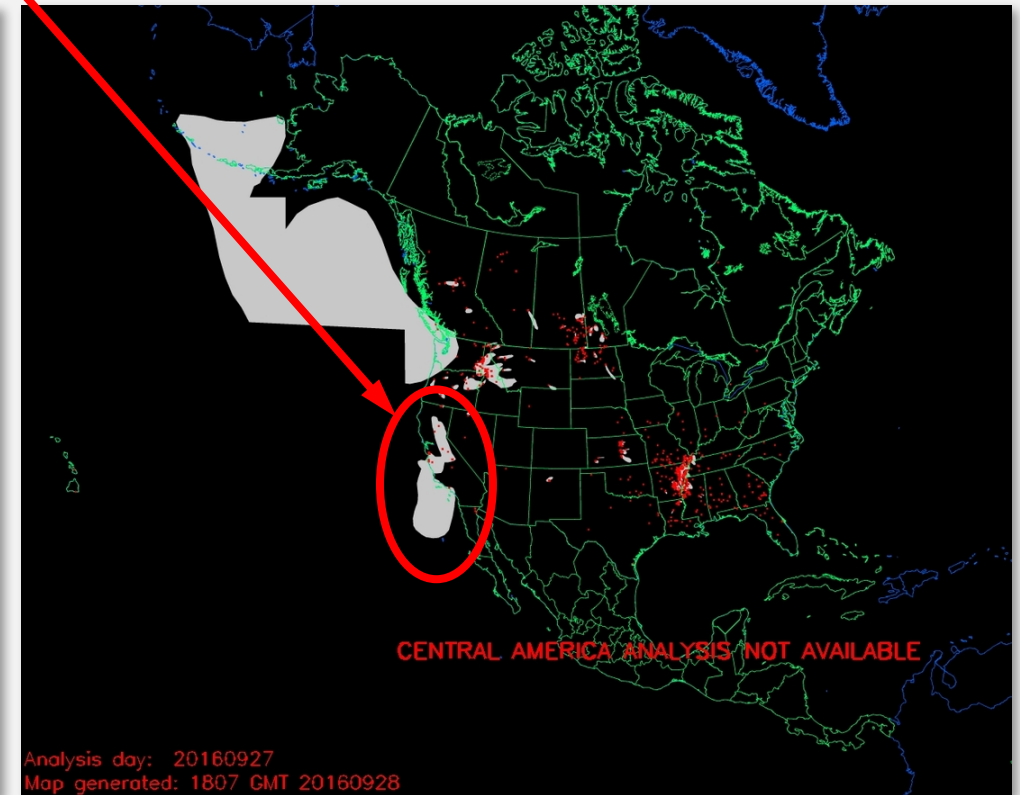


# HMS Fire & Smoke Analysis: Example

## California Fires



September 26, 2016

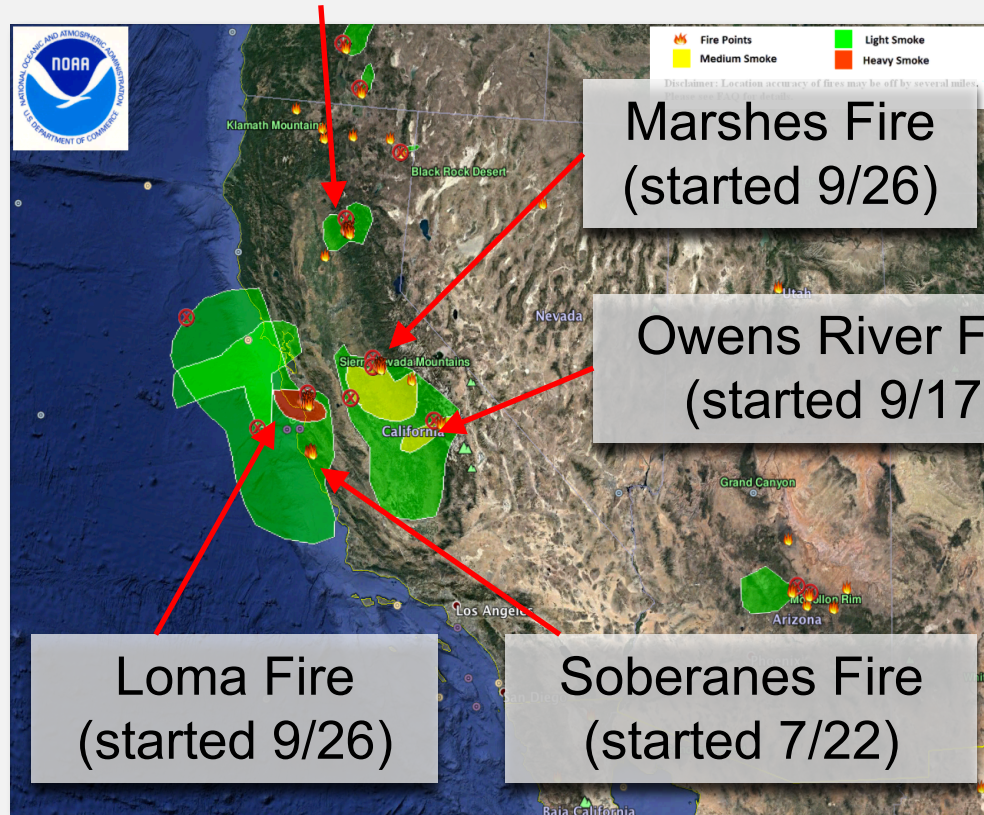


September 27, 2016

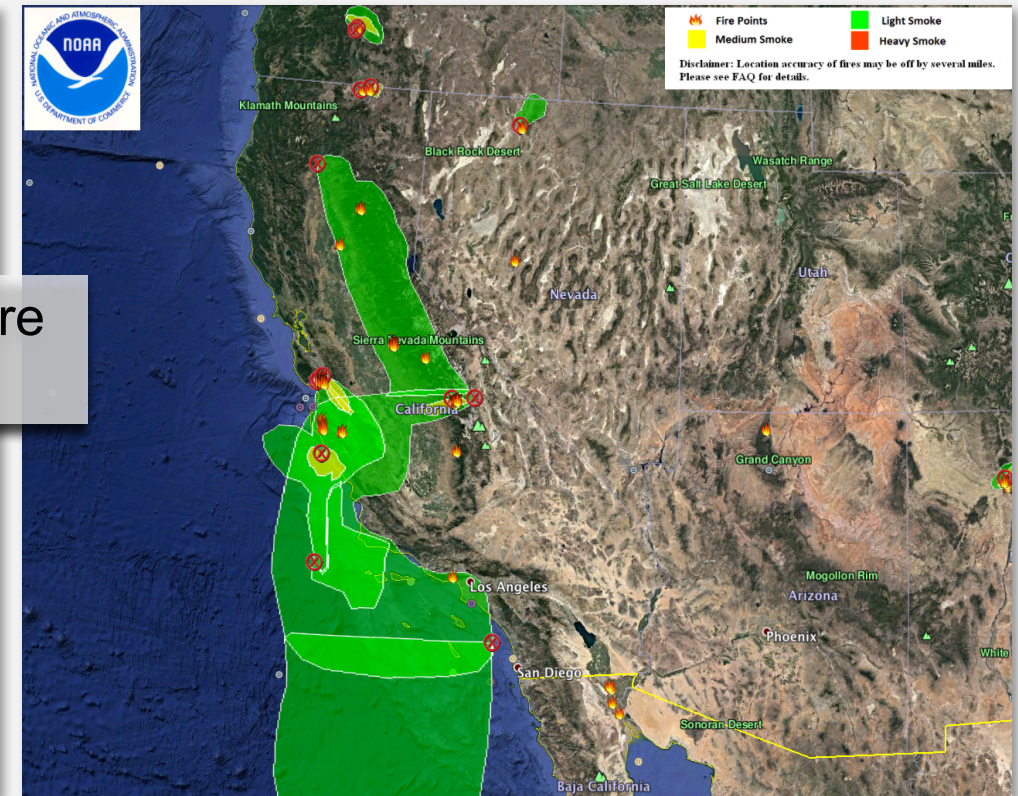


# HMS Fire & Smoke Analysis: Example

Tobin Fire (started 9/26)



September 26, 2016



September 27, 2016

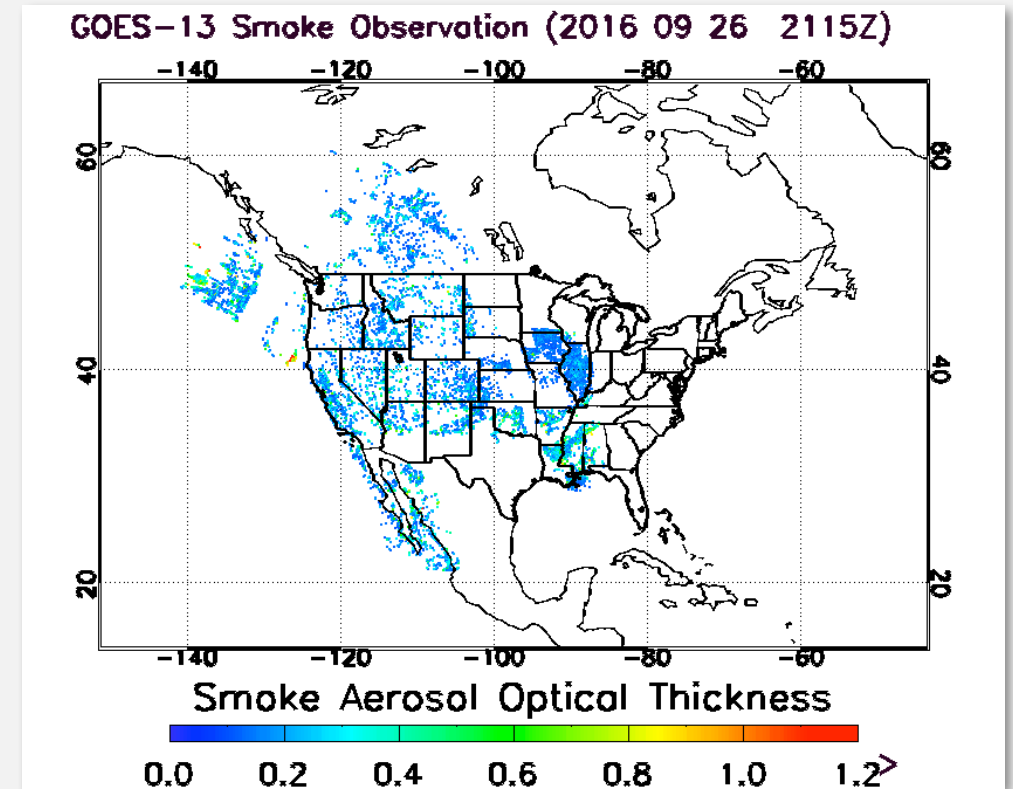




# GOES Aerosol Smoke Products (GASP)

<http://www.ssd.noaa.gov/PS/FIRE/ASDTA/asdta.html>

- Provides aerosol optical depth (AOD) using GOES
- Available at 30 min intervals
- Not retrieved where clouds are present
- Pattern recognition technique for plumes transported long distances





The background is a satellite map showing a landscape with green fields, brown patches, and dark blue water bodies. A semi-transparent white rectangular box is centered over the map, containing the text 'Additional Products and Tools'.

# Additional Products and Tools

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# U.S. Forest Service Active Fire Mapping Program

<http://activefiremaps.fs.fed.us/index.php>

- Satellite detection and monitoring of wildfire activity in CONUS, Alaska, Hawaii and Canada
- Leverage NASA and NOAA assets:
  - GOES, AVHRR, MODIS, VIIRS
- Provision of comprehensive, NRT data are essential
- Facilitates decision support for strategic planning and response for U.S. and Canadian fire agencies







# MODIS & VIIRS Data Subsets

- Daily imagery subset into different regions of the Contiguous US, Alaska, and Canada
- Scroll through daily thumbnail images
- Obtain true color and false color jpeg images
- Obtain true and false color GeoTIFF files
- Can download data as shapefile on the “Fire Detection in GIS” page


**Fire Imagery - Remote Sensing Applications Center**




This image subset is provided as a 3-band JPEG or GeoTIFF, or as a 7-band BSQ (band sequential) image. [Click here](#) for a description of the 7 MODIS spectral bands used for land remote sensing and subset projection information.




Bands 1, 4, 3  
True Color  
(JPEG)  
655.81 KB



Bands 7, 2, 1  
False Color  
(JPEG)  
656.65 KB




Bands 1 - 7  
(BSQ)  
10.63 MB



True and False Color  
(GeoTIFF)  
6.2 MB

Use this calendar to access previously acquired imagery

October 2016						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
25	26	27	28	29	30	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5



California (North)  
10/04/2016  
21:57:58 GMT  
Satellite: Aqua



# Fire Detection in Google Earth

- Obtain KML files using MODIS, VIIRS, Landsat, AVHRR, and GOES data
- Data Available
  - Fire Detections
  - Fire Radiative Power (intensity)
  - Large Incidents
  - Fire Weather
- Links for current (last updated) and historical data
- Animations of latest data also available

## Fire Data in Google Earth



Continental United States

**KML**  
Fire Detections (MODIS): [Current](#) | [Animation](#) | [Historical](#)  
Fire Radiative Power (MODIS): [Current](#) | [Animation](#) | [Historical](#)  
Large Incidents: [Current](#) | [Historical](#)  
Fire Weather: [Current](#)  
AFM KML Bundle: [Current](#)

**KML Access:**  
The links below provide access to several geospatial datasets relevant to fire management in Keyhole Markup Language (KML/KMZ) format for use in Google Earth and other virtual globe applications. Geospatial data are organized by specified geographic region and include location and characterization of satellite fire detections, current large incident locations and NWS fire weather forecasts.

All KMLs update automatically to ensure availability of the latest information (Current link). Animated time series KMLs are provided for the latest updates of each of the fire detection data layers (Animation link). Access to KMLs for previous dates are provided for relevant data layers (Historic link).

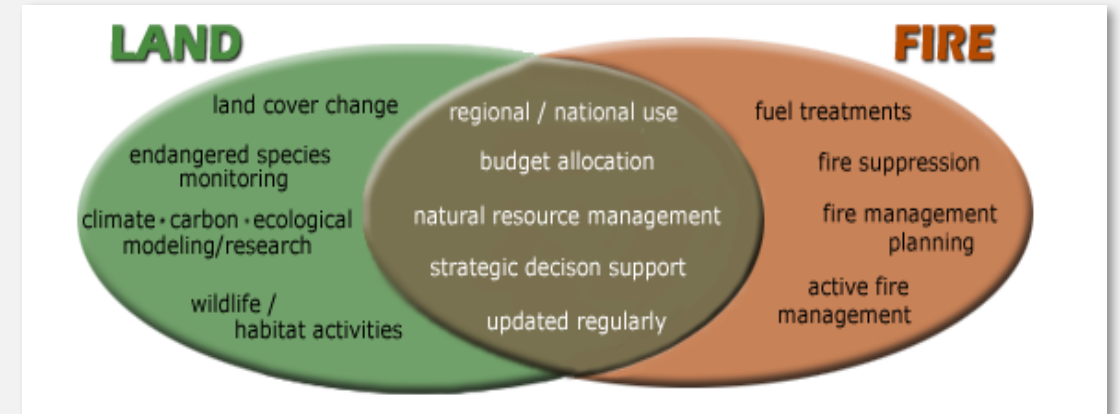
**KML Descriptions:**  
**Fire Detections** - MODIS (1km), VIIRS (375m and 750m), Landsat 8 (30m), AVHRR (1km) and GOES (4km) fire detections by time/date of occurrence within the last 6, 12 and 24 hours, and the 6 days previous to the last 24-hour period.  
**Fire Radiative Power** - Measured fire radiative power (fire intensity) for MODIS fire detections within the last 6, 12 and 24 hours, and the 6 days previous to the last 24-hour period. *Available for MODIS and VIIRS-AF only.*  
**Large Incidents** - Location and intelligence information of large wildfire incidents currently being tracked by the National Interagency Fire Center (NIFC) and Canadian provincial and territorial fire management agencies.  
**Fire Weather** - Current National Weather Service fire weather watch and red flag warnings by fire weather zone. *Available for CONUS, Alaska and Hawaii only.*  
**AFM KML Bundle** - A single KML containing all available KMLs provided by the Active Fire Mapping Program for each geographic area.



# LANDFIRE

<http://www.landfire.gov>

- Joint program between wildland fire management programs of USDA Forest Service and US Department of Interior
- Provides consistent and comprehensive geospatial data for vegetation, wildland fuel, and fire regimes in the U.S.
  - Data and reports
  - Videos and tutorials
  - Decision-making tools

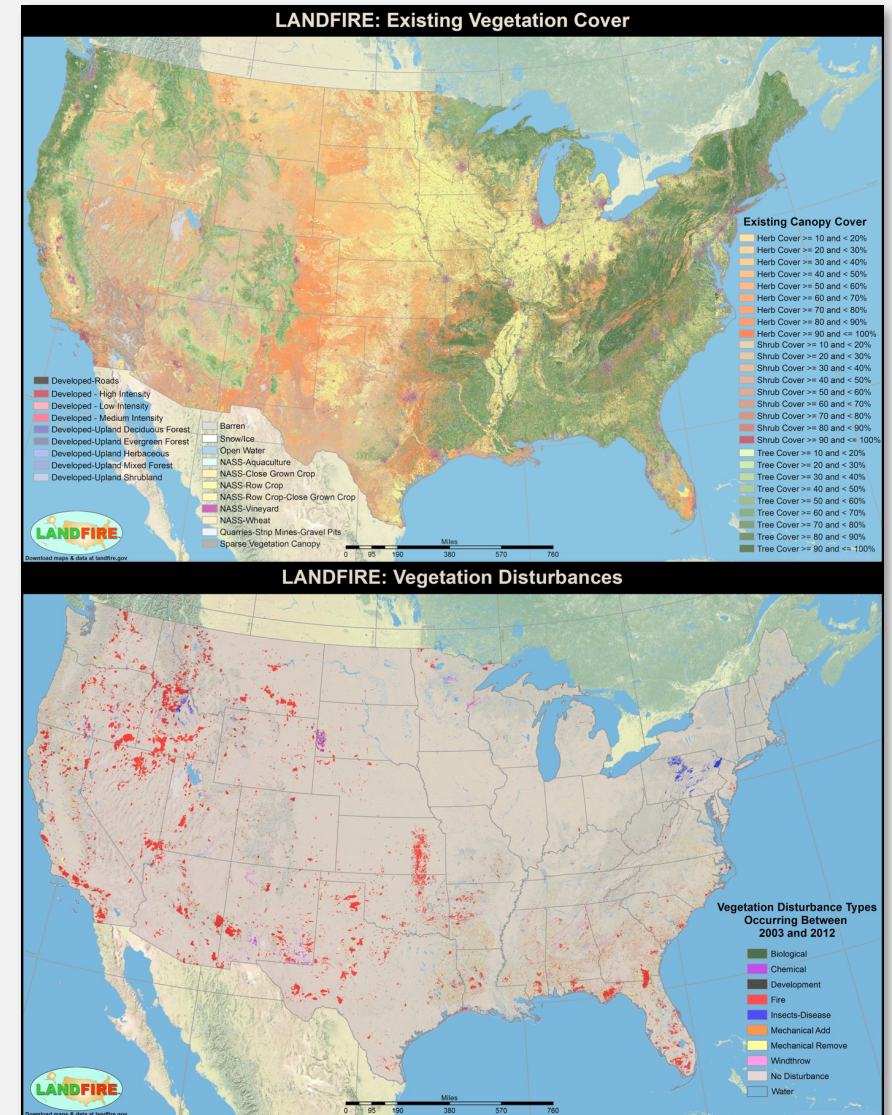




# LANDFIRE Products

- Products
  - Delivered at 30 m spatial resolution
  - Available from 1999-present
- Vegetation data layers using Landsat imagery
- Fuel and Fire Regime data layers
  - Fire behavior and fuel loading models
- Disturbance data
  - Fuel, vegetation, natural, and prescribed disturbance by type and year

Current vegetation cover map (top) and vegetation disturbances map from 2003 to 2012 (bottom) available at LANDFIRE. Image Credit: U.S. Forest Service.

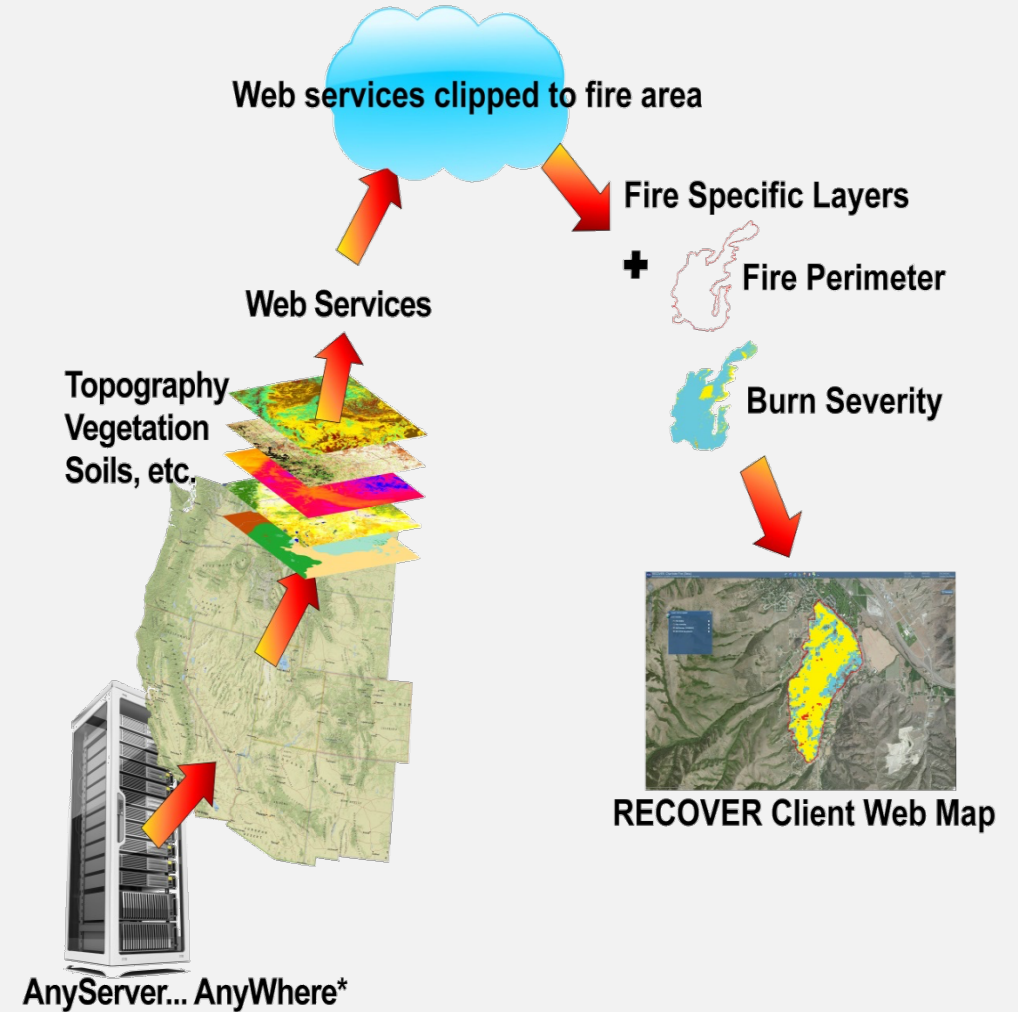




# RECOVER

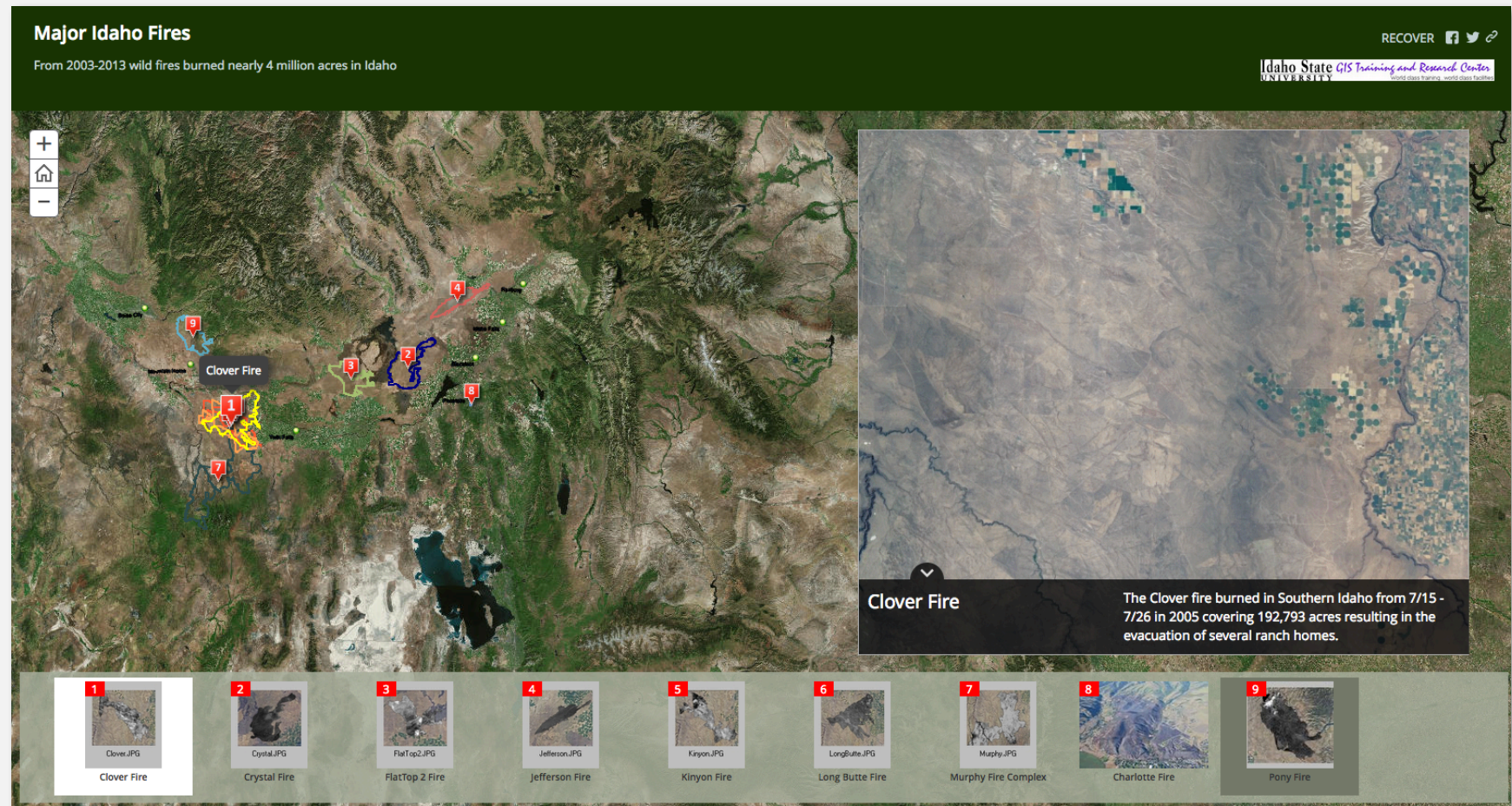
[http://giscenter.isu.edu/research/Techpg/nasa\\_RECOVER](http://giscenter.isu.edu/research/Techpg/nasa_RECOVER)

- RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery
- Operated at the Idaho State University GIS training and research center
- NASA Applied Sciences Program sponsored project
- Decision Support System (DSS)
  - Rapid assembly of site-specific data
  - Delivered in customized GIS analysis environment
  - Wildfire focus





# RECOVER



Example of RECOVER interface. Data available for the outlined major Idaho fires includes burned area extent, fire severity, topography, and soil data



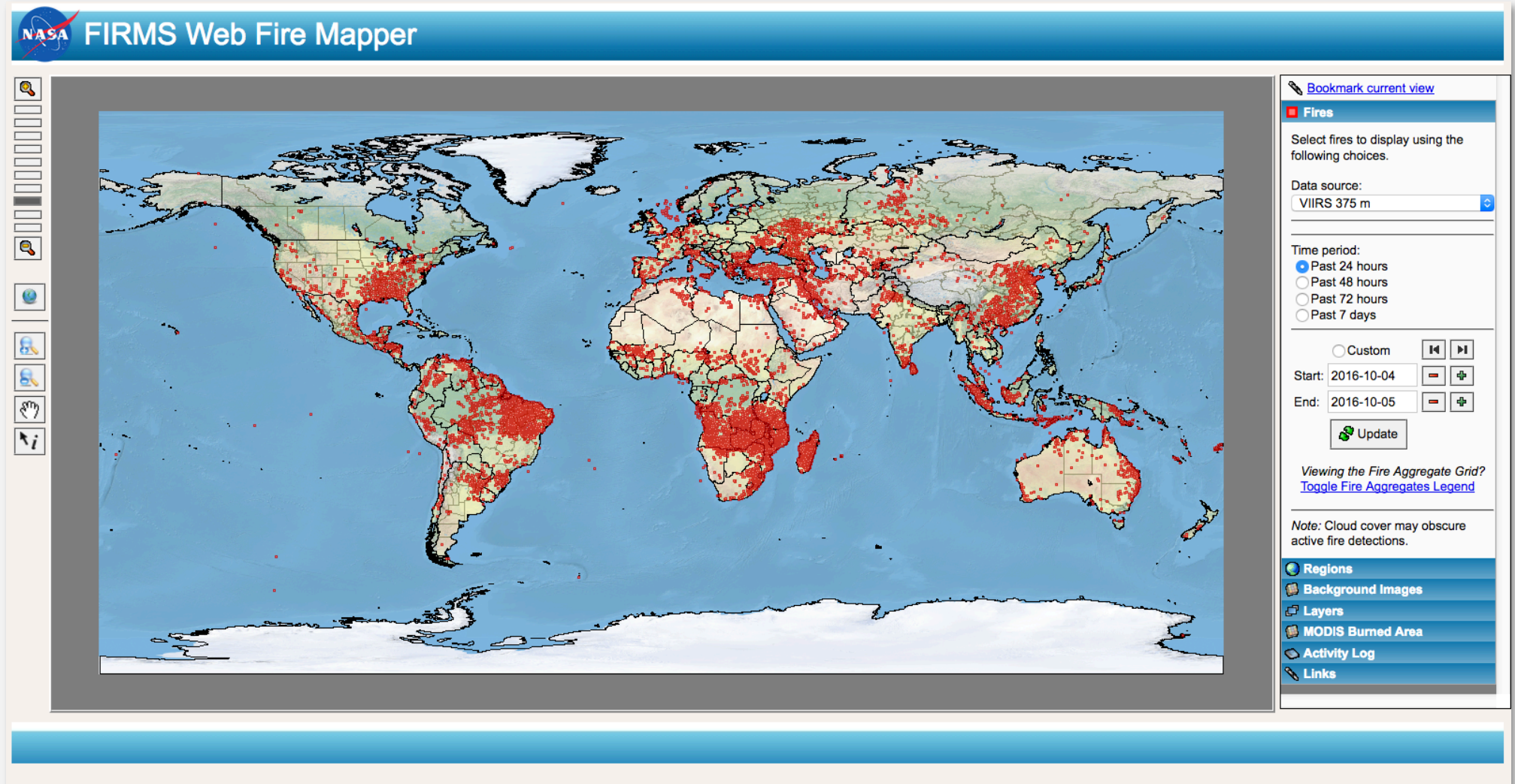
An aerial photograph of a forested landscape with a semi-transparent rectangular text box in the center. The text box contains the word "Exercise" in a black serif font, with a horizontal line extending to the right from its base. The background shows a dense forest with various shades of green and brown, and a winding river or stream visible in the upper right.

# Exercise

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# FIRMS Web Fire Mapper





An aerial photograph of a lush, green forested landscape. A winding river or stream flows through the center of the image. The terrain is covered in dense vegetation, with some areas appearing more open or cleared. A semi-transparent rectangular box is overlaid on the center of the image, containing the text 'Additional Sites and Tools for Data and Products'.

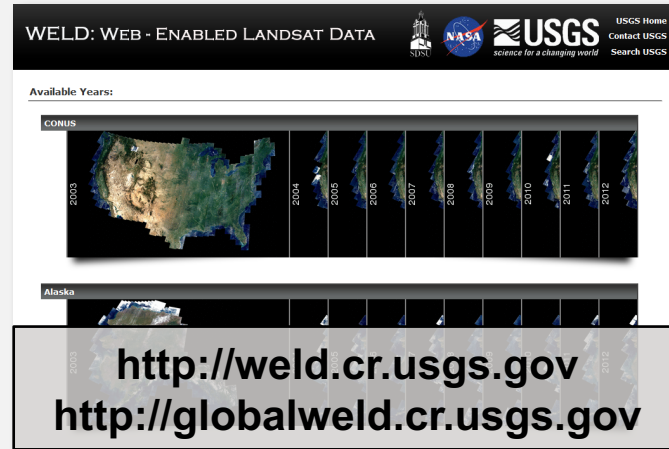
# Additional Sites and Tools for Data and Products

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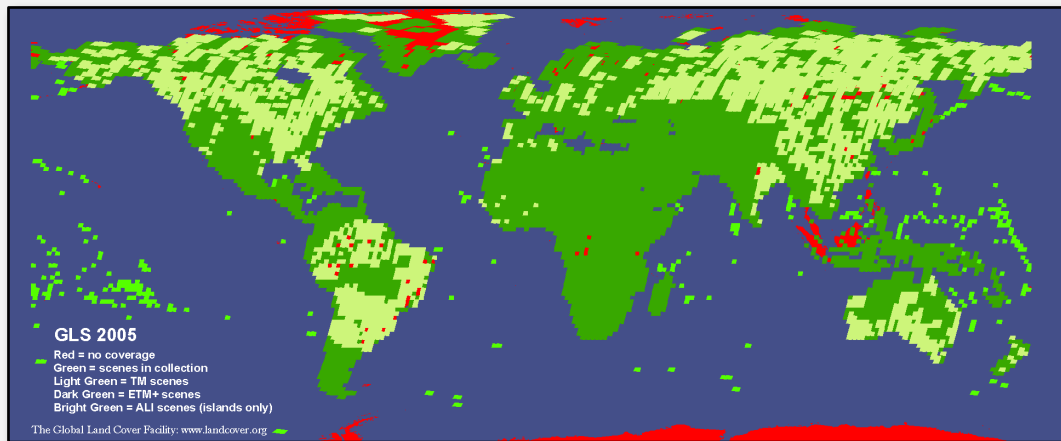
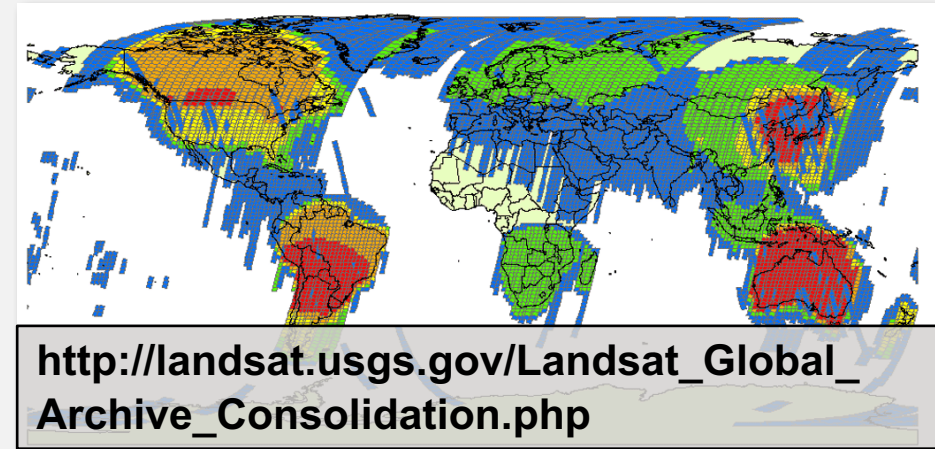


# Where to Obtain Landsat Images

## WELD



## Landsat Global Archive Consolidation (USGS)



- Global Land Survey
- Not a data portal, but a global collection of cloud free Landsat images from 1975-2008.
- Time series include (GLS 1975, GLS 1990, GLS 2000, GLS 2005, GLS 2010)
- Acquire GLS datasets through Earth Explorer, GloVis, and GLCF



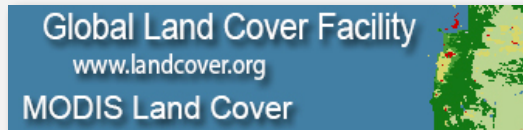
# Where to Obtain MODIS Products



Fire Information for Resource Management System (FIRMS): <https://earthdata.nasa.gov/data/near-real-time-data/firms>



MRTWeb: <http://mrtweb.cr.usgs.gov>



GLCF: <http://www.landcover.org/data/lc>



GLOVIS: <http://glovis.usgs.gov>



Data Subsetting and Visualization: Oakridge National Lab DAAC (ORNL DAAC): <http://daac.ornl.gov>



Visualization, SERVIR: <http://www.servirglobal.net/Global/MapsData/InteractiveMapper.aspx>